Aviation Week

Including Space Technology

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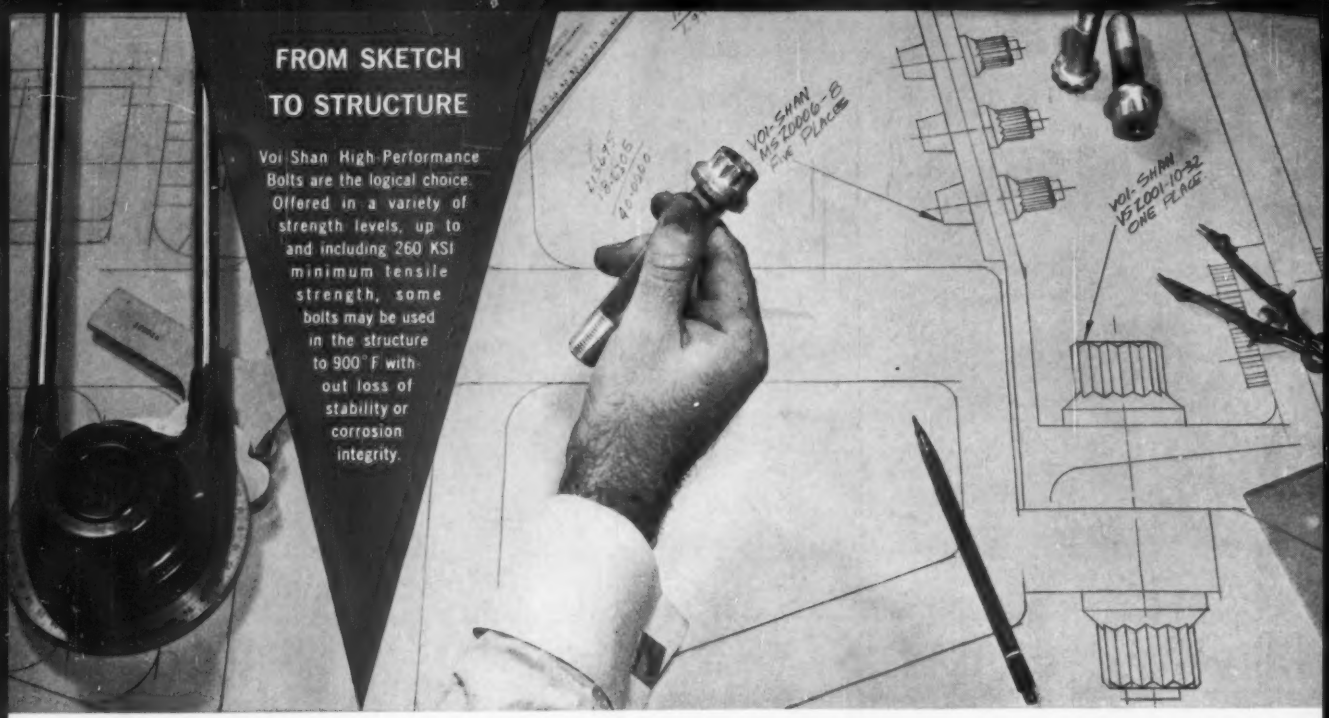
A McGraw-Hill Publication

October 26, 1959

First Design Details Of Kaman HU2K

Kaman HU2K-1 Utility Helicopter

Vandenberg Trains USAF Missile Crews



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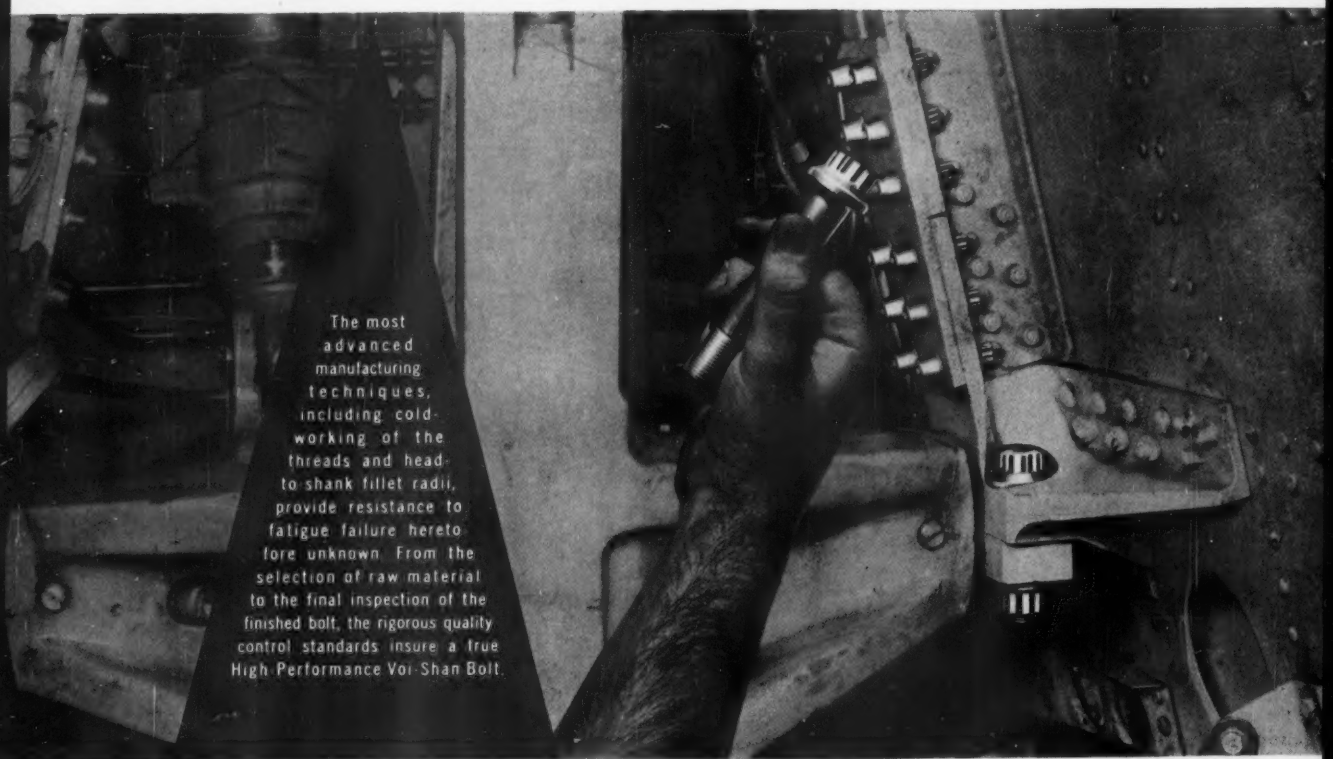

The most advanced manufacturing techniques, including cold-working of the threads and head-to-shank fillet radii, provide resistance to fatigue failure heretofore unknown. From the selection of raw material to the final inspection of the finished bolt, the rigorous quality control standards insure a true High-Performance Voi-Shan Bolt.

Boeing 707 structure photo, courtesy American Airlines

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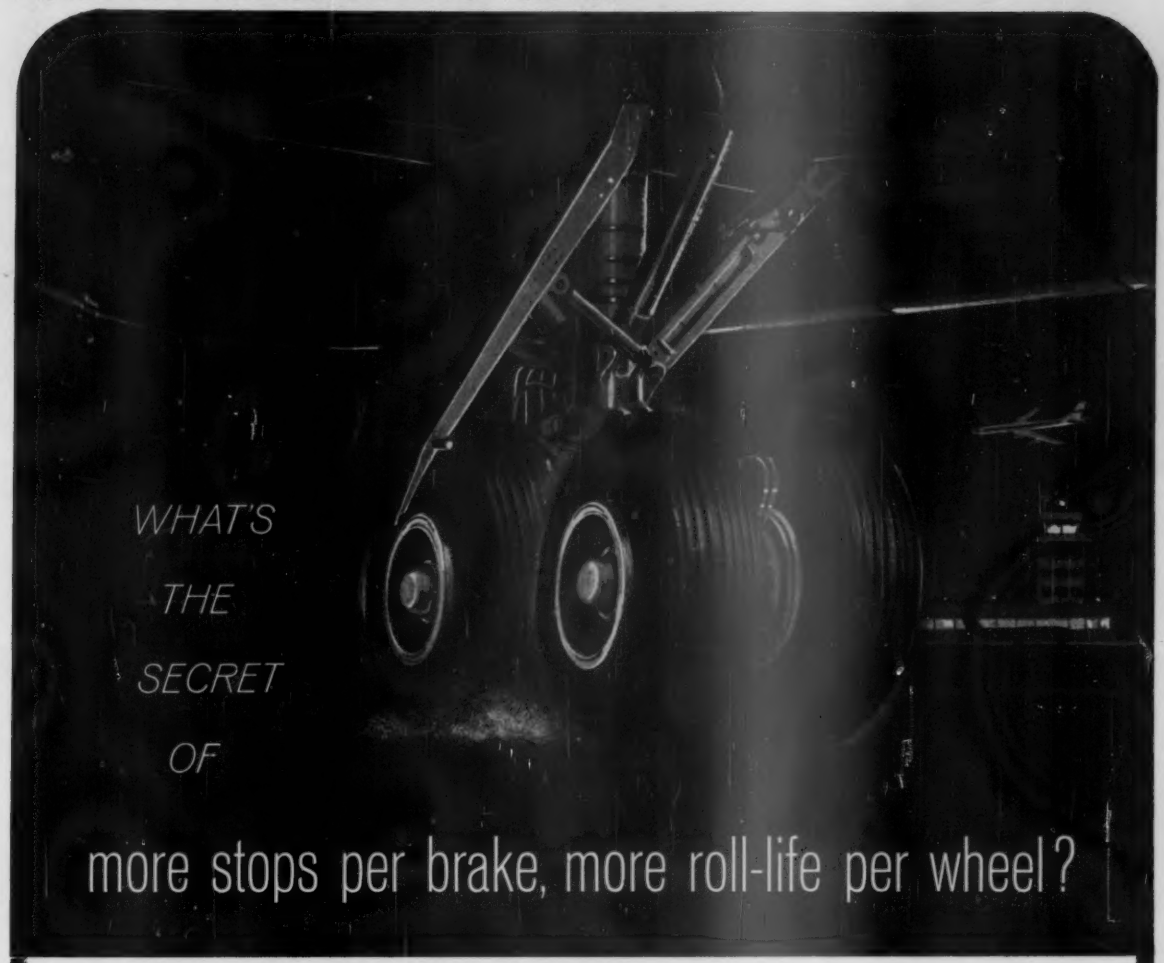

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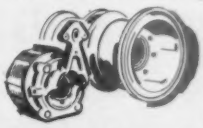

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59-4

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Aircraft Division

AVIATION CALENDAR

Oct. 28-30—Symposium on Sealants and Sealing of Aircraft, Missiles and Electrical Components, Society of Aircraft Metals and Processing Engineers, Institute of the Aeronautical Sciences Bldg., Los Angeles, Calif.

Nov. 2-4—National Midwestern Meeting on New Frontiers in Aviation, Institute of the Aeronautical Sciences, Hotel Lassen, Wichita, Kan.

Nov. 2-5—Fall Meeting, Western States Section, Combustion Institute, Institute of the Aeronautical Sciences Bldg., Los Angeles, Calif. Subject: Equilibria and Performance of High Temperature Systems.

Nov. 3-5—11th Annual Mid-America Electronics Conference, Hotel Muehlebach, Kansas City, Mo. Sponsor: Institute of Radio Engineers' Kansas City Section.

Nov. 4-6—National Automatic Control Conference, Sheraton Hotel, Dallas, Tex. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Instrument Society of America; American Society of Mechanical Engineers. AIEE is conducting a parallel Control System Components Conference on Nov. 5-6.

Nov. 9-11—Fourth Instrumentation Conference and Exhibit, Biltmore Hotel, Atlanta, Ga. Sponsors: Institute of Radio Engineers' Professional Group on Instrumentation and the Atlanta Section.

Nov. 9-20—13th Annual Air Transportation Institute, American University's School of Business Administration, Washington, D. C.

Nov. 11-13—16th National Meeting, Operations Research Society of America, Huntington-Sheraton Hotel, Pasadena, Calif.

Nov. 12-13—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Marrott Hotel, Indianapolis, Ind.

Nov. 16-19—14th Annual Meeting and As-

(*Continued on page 8*)

AVIATION WEEK Including Space Technology

October 26, 1959

Vol. 71, No. 17

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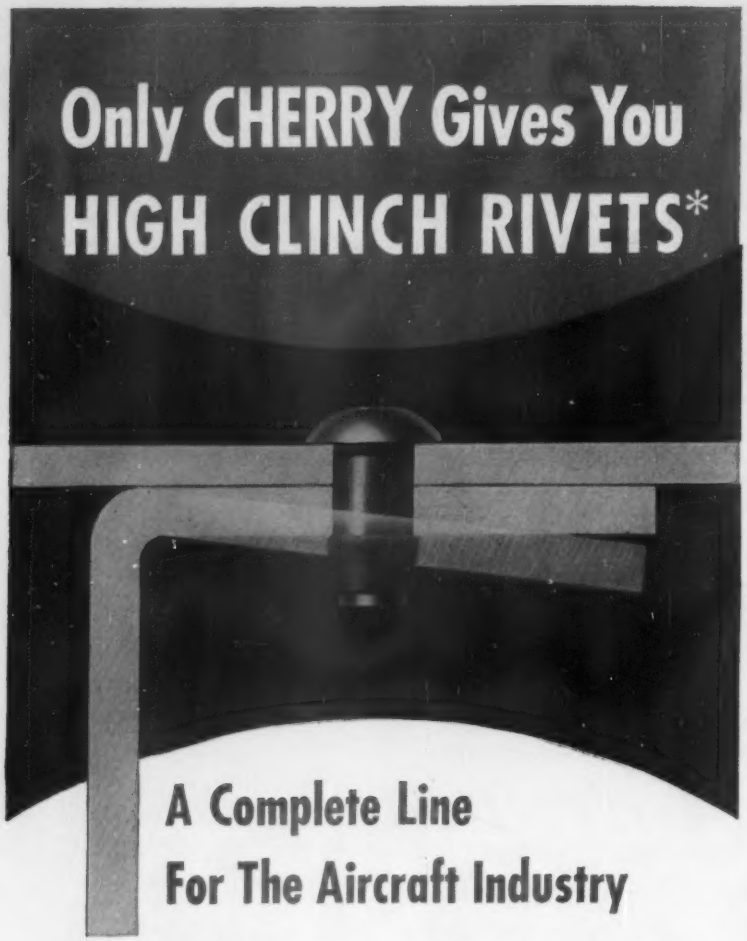

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AVIATION CALENDAR

(*Continued from page 7*)

tronautical Exposition, American Rocket Society, Sheraton-Park Hotel, Washington, D. C.

Nov. 16-20—20th Annual Convention, National Aviation Trades Assn., Hotel Montleone, New Orleans, La.

Nov. 17—Fall Meeting, Society of Aircraft Materials and Process Engineers' Eastern Division, Sheraton Carlton Hotel, Washington, D. C.

Nov. 17-18—Technical Seminar, American Society of Tool Engineers, Sheraton Hotel, Philadelphia, Pa. Topic: Problems of Machining Space Age Metals.

Nov. 17-18—National Turbine-Powered Air Transportation Meeting, Institute of the Aeronautical Sciences, Fairmont Hotel, San Francisco, Calif.

Nov. 17-19—34th Meeting, Aviation Distributors and Manufacturers Assn., Diplomat Hotel and Country Club, Hollywood, Fla.

Nov. 17-19—1959 Northeast Electronics Research and Engineering Meeting, Institute of Radio Engineers, Boston Commonwealth Armory, Boston, Mass.

Nov. 19-20—Seventh Annual Aircraft and Missile Division Conference, American Society for Quality Control, Sheraton-Dallas Hotel, Dallas, Tex.

Nov. 23-24—Symposium on Solid Facts about Solid State, Instrument Society of America, Ben Franklin Hotel, Philadelphia, Pa.

Nov. 30-Dec. 4—Fourth Annual Naval Air Weapons Meet, Operation "Top Gun," Marine Corps Auxiliary Air Station, Yuma, Ariz.

Nov. 30-Dec. 4—First industry and government-wide training course in Value Engineering & Analysis, Industrial Education Institute, Boston, Mass.

Dec. 1-3—Eastern Joint Computer Conference, Statler Hilton Hotel, Boston, Mass. Sponsors: Institute of Radio Engineers; American Institute of Electrical Engineers; Assn. for Computing Machinery.

Dec. 7-8—Classified symposium on "The Plasma Sheath, Its Effect on Communication and Detection," Boston, Mass. Sponsor: Electronics Research Directorate, Air Force Cambridge Research Center.

Dec. 7-11—National Conference on the Application of Electrical Insulation, Sheraton-Park Hotel, Washington, D. C. Sponsors: American Institute of Electrical Engineers; National Electrical Manufacturers Assn.

Dec. 8-9—First Aerospace Finishing Symposium, Hotel Texas, Fort Worth, Tex. Sponsors: Society of Aircraft Materials and Process Engineers; Dallas-Fort Worth Branch, American Electroplaters Society.

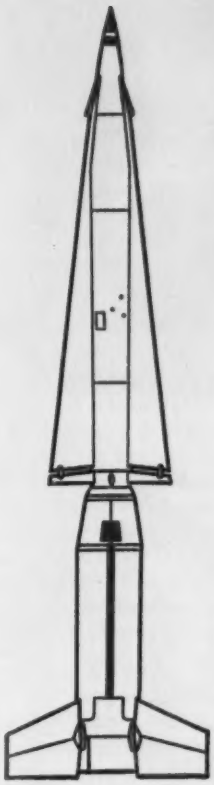
Dec. 17—23rd Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C. Dr. Alexander H. Flax, chief Air Force scientist, will speak on "High Temperatures in Hypersonic Flow—Physical Principals and Experimental Techniques." Dr. Flax will repeat his lecture on Dec. 18 before the IAS Cleveland Section, on Dec. 21 before the IAS Los Angeles Section, and on Dec. 22 before the IAS Texas Section.

The man:

A U.S. Army missileman working with Nike Hercules missile equipment. The modern Army relies heavily on the special skills and knowledge of men like this who are trained extensively in military schools, and supported technically in the field by Army Ordnance Corps, Western Electric and Douglas field service men.

The mission:

Defense of U.S. cities. Army Nike Hercules units are already on duty at many key points...have the important assignment of guarding against enemy aircraft.



The missile:

Douglas-built Nike Hercules, product of a Douglas-Western Electric-Army Ordnance team, has successfully engaged supersonic drone targets at altitudes well over 60,000 feet. Other drone targets have been destroyed up to 100,000 feet, and at ranges beyond 75 miles.

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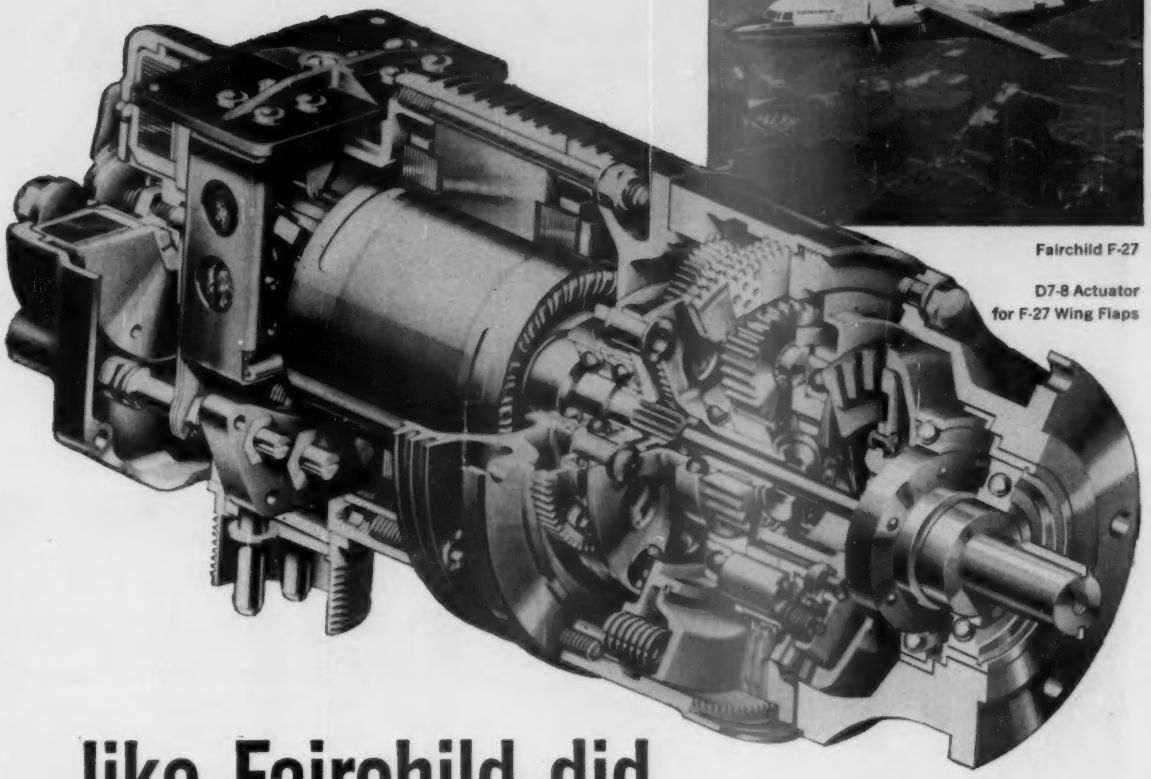

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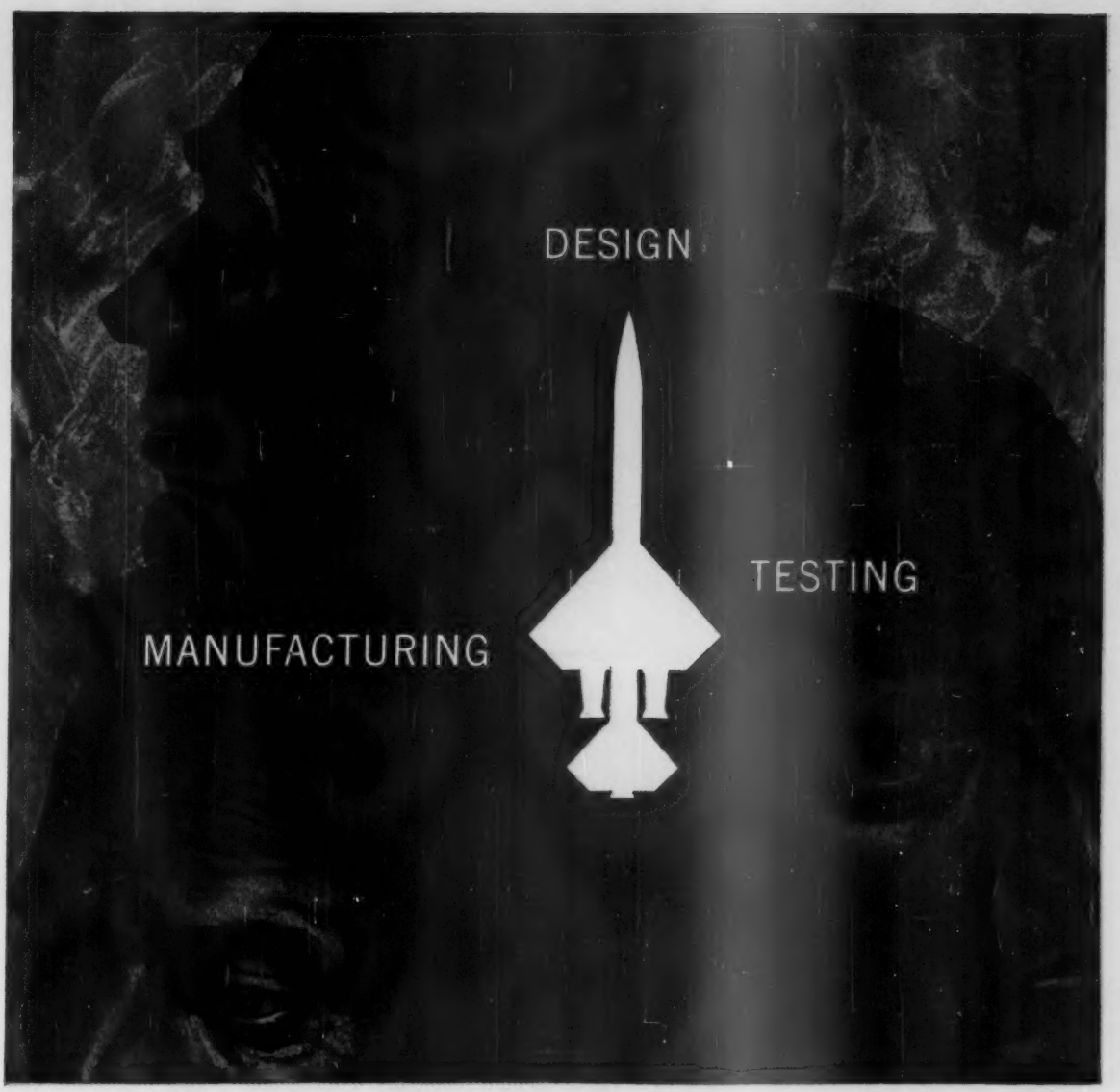

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At 10:15 the general superintendent calls; he's got to get to Worksite Alice; no landing strip nearby, and a four-hour drive each way. But by 1:45 you're back. Then at 2:10 the president's secretary calls you to pick up a customer at the airport and fly him into town, twenty miles away. This done, you've just walked in when another phone voice asks you to pack litter gear, stop in town for the doctor and fly to Worksite Cloudloft to handle an injured man. And so it goes.

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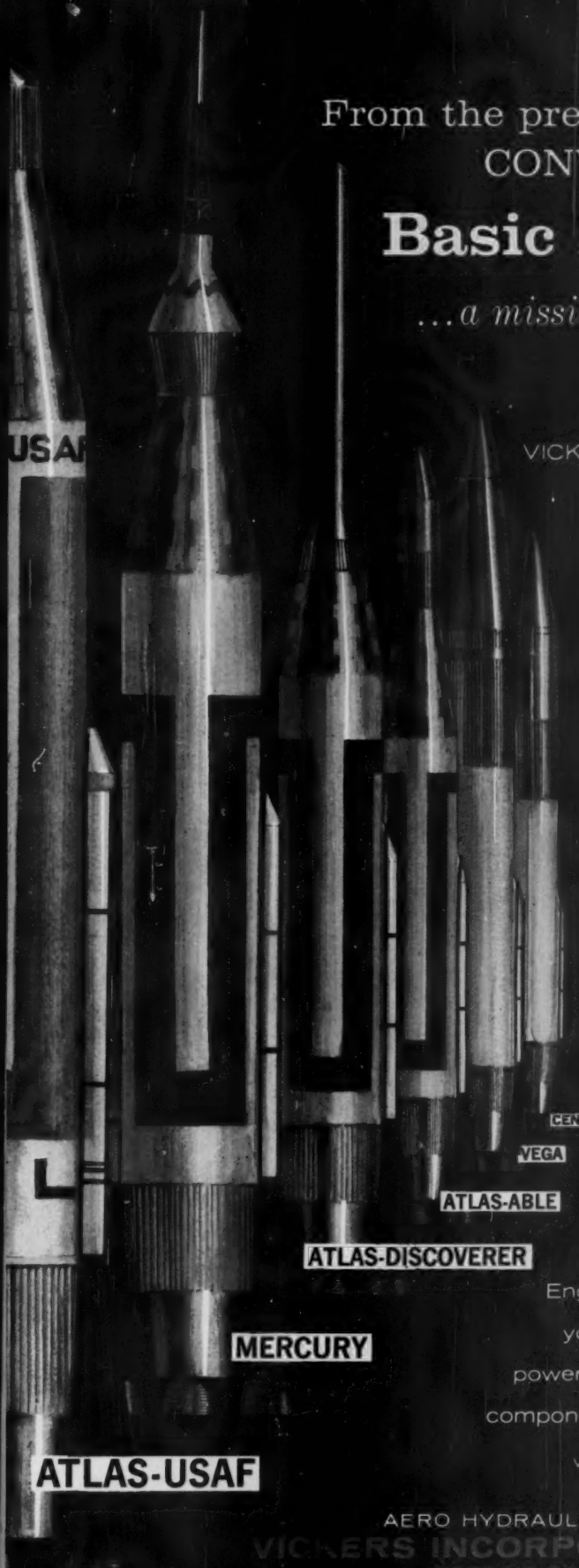

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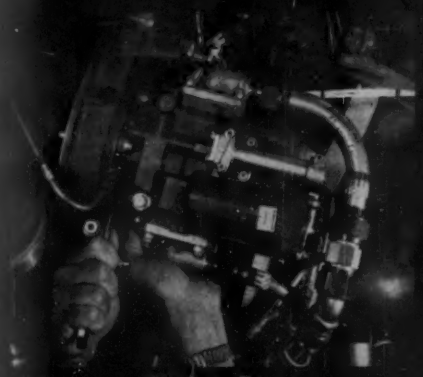

Vickers Pump Being Installed on Atlas

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Aeronca produces the precision parabolic radar reflectors as a D-T-P* "envelope" project, on a subcontract basis. Highly specialized skills and facilities are required to meet their stringent specifications.

A pioneer in honeycomb sandwich fabrications, Aeronca has the versatile, integrated facilities necessary to supply weapon system envelopes *efficiently, economically and on-schedule.*

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*Fabricated to curvature tolerances of ±.005", these precision honeycomb structures illustrate Aeronca's coordinated Design-Tool-Produce capability.

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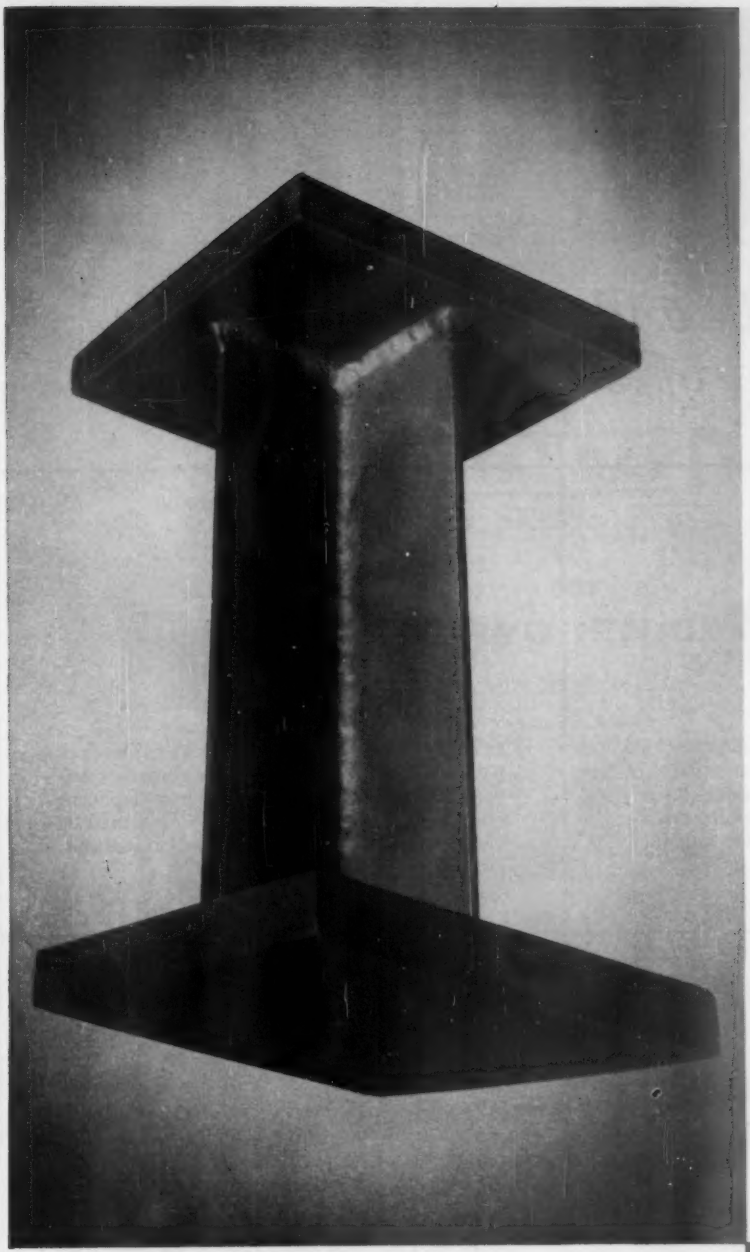
Operational expansion has created openings for additional senior engineers. Write to W. W. Gordinier, Personnel Manager.



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continues to pace industry in the field of metal structures. Current advanced programs are solving the problems of **economical application** of new and

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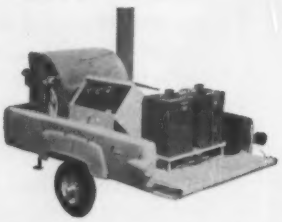
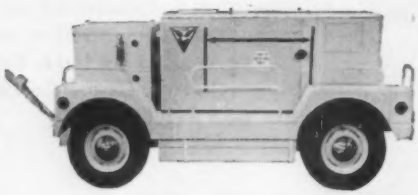
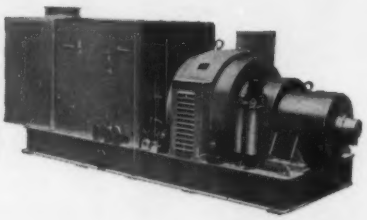


WHEELED VEHICLES: Solar's GSE capabilities include the design, development and manufacture of specialized powered and towed vehicles—including large trucks and semi-trailers—for missile transport, ground handling and other important support applications.

ELECTRONIC EQUIPMENT: Electronic Systems Development Corp., a Solar subsidiary, has broad experience in electronic systems for airborne, shipboard and ground installations—including missile checkout, data processing, communications, ground test and others.



MULTI-PURPOSE SERVICING UNITS: Support equipment is a natural outgrowth of Solar's early experience in fabricating advanced metal structures for specialized applications. Current units include dolly- and truck-mounted starting and servicing units for advanced military and commercial jets.



POWER PACKAGES: Solar emphasizes reliability in all of its support equipment. Among the more than 2000 major units of support equipment produced by Solar are reliable, lightweight gas turbine-driven generators for important ground, airborne and shipboard applications.

Underlying Solar's support equipment capabilities is a weapon systems team of selected scientists and engineers with years of active experience in the GSE field. For detailed information write today to Dept. G-156, Solar Aircraft Company, San Diego 12, California.

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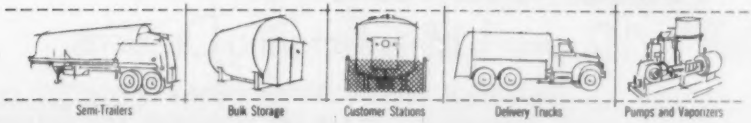

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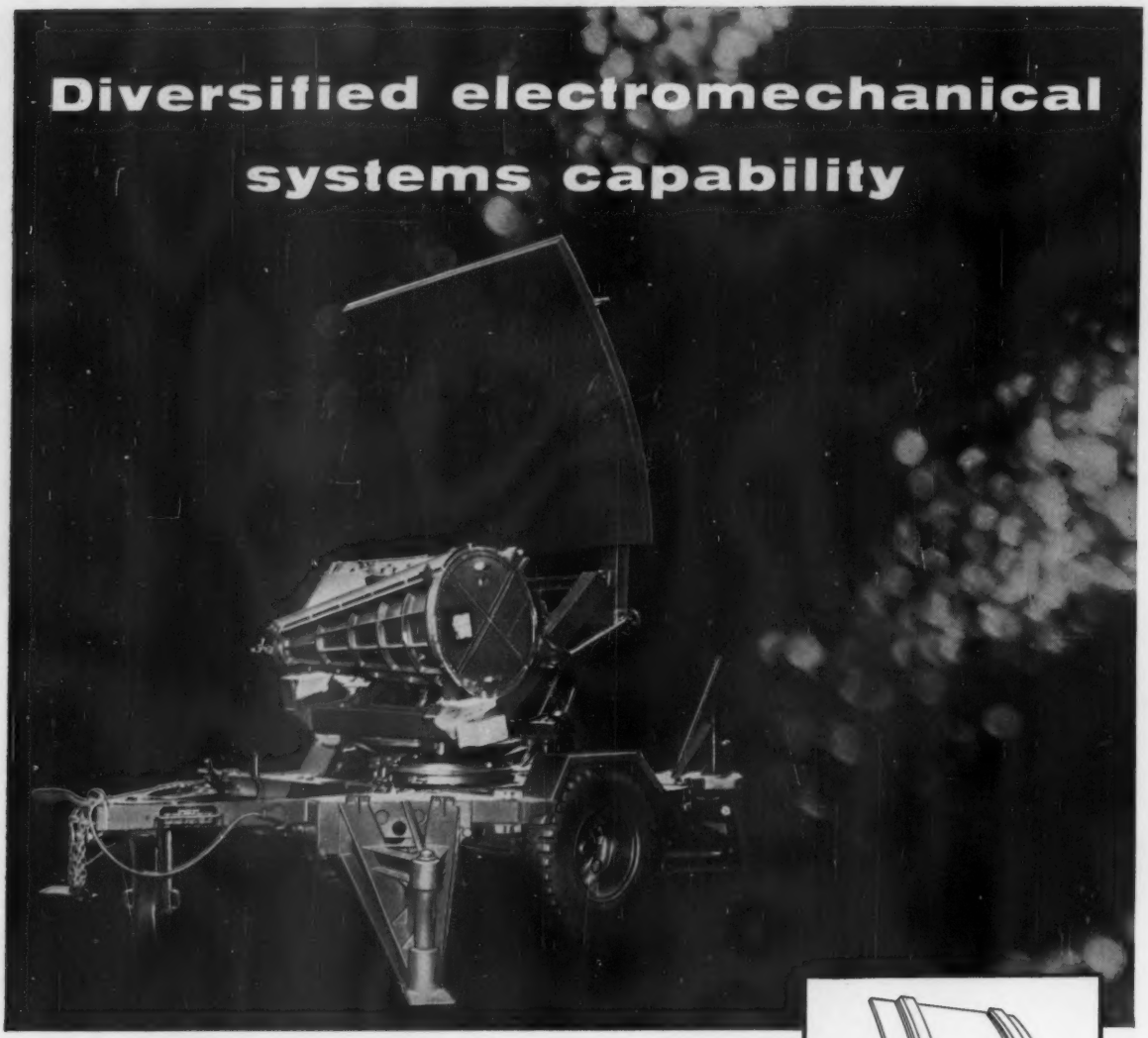
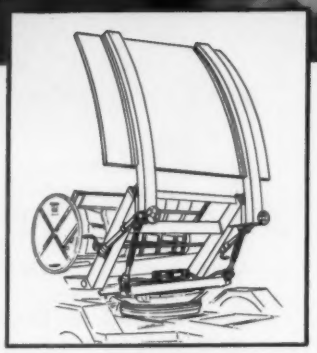
Diversified electromechanical systems capability



AiResearch Actuation Systems For Portable Radar represent a typical electromechanical systems application in ground support equipment. Two types of AiResearch actuation systems are now in production for the Army's mobile trailer-mounted ground radar unit. They consist of a manually operated antenna folding storage system and an electrically powered antenna elevation system.

Designed to operate under the most severe environmental conditions, this type of electromechanical system can operate on 60 cycle A.C., 400 cycle A.C., or 28 volt D.C. Other suggested applications include: *missile launchers, missile ground handling and support equipment, armored vehicle fire control and ballistic handling systems, and mobile communications equipment requiring servoed actuating systems.*

AiResearch leadership in the development and production of electromechanical equipment for aircraft, ground handling, ordnance and missile systems of all types also includes such recent examples as spoiler servo control systems, magnetron and Klystron tuning devices, and safe-arm mechanisms for missile igniting. We invite you to submit a problem statement of your electromechanical requirements.



U.S. Army Signal Corps ground portable radar unit operated with two AiResearch electromechanical actuation systems.

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October 26, 1959

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PICTURE CREDITS

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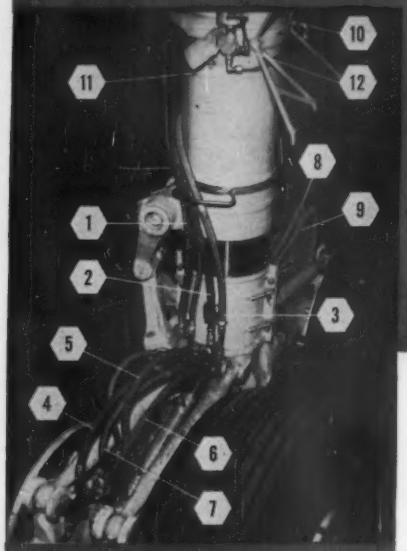

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EDITORIAL

Modernized Airlift

(Sen. A. S. (Mike) Monroney (D.-Okla), chairman of the Senate Commerce Committee's aviation subcommittee who stressed throughout the last session of Congress the need for a modernized airlift program, announced plans last week to introduce a bill at the next session authorizing government guarantees of private loans to airlines for the purchase of modern cargo aircraft. The reasons behind this move were outlined by Sen. Monroney at the annual banquet of the Wings Club in New York. Because of its general interest, AVIATION WEEK is reprinting below significant portions of the speech.)

America invites the danger of hydrogen warfare by its failure to provide an adequate airlift to implement its ground force mobility. . . .

Everywhere I have been in Europe during the past month I found leaders in political and business life there concerned with the state of America's defense posture. This is not because they doubt the capacity of our nuclear weapons or our missiles. What they fear is that we may yield important local situations, such as Berlin, because our strength is too greatly concentrated in huge atomic and hydrogen weapons.

We appear to be muscle-bound atomically for this type of local pressure, causing fears among our allies that rather than launch an atomic World War III we would yield vital but small areas to reach settlements.

Because of our necessity to stand firm against another Munich, we should implement our defenses with high mobility through a modern airlift capable of moving several divisions anywhere in the world on a few hours' notice. Such movement would require planes of sufficient size and range to land them in troubled areas with airborne equipment ready to fight. . . .

We do not need to match division for division the ground strength of the Soviet forces, if we show them that we have a modern and mobile army ready to instantly reinforce the NATO forces where trouble is threatened. . . .

Today our airlift is almost non-existent. We have one of the finest and safest airlines in the world, but it is largely a passenger transport service. The 400 planes of the Military Air Transport Service are hopelessly inadequate to furnish an ever-ready airlift of sufficient proportions to move war materiel and men great distances in a hurry. Only 36 can fly nonstop to Europe. Should our island bases be bombed, we would be largely grounded.

Of the 400-plus planes in the MATS fleet, all but 33, the C-133s, are obsolete. Instead of airlift, we have 28 VIP planes, including three presidential jets. We have 191 obsolete passenger aircraft and 218 C-124s, the old Globemasters. This 'backbone' of our cargo airlift was designed in 1947, first produced in 1948, and production was terminated in 1955. Parts and motors are no longer manufactured and the upkeep and maintenance is tremendously expensive. . . .

We have seen the last of three great Army leaders, Gen. Maxwell Taylor, resign because of the failure of the Defense Department to furnish adequate airlift for his troops. Before Gen. Taylor, there were Gen. Ridgeway and Gen. Gavin, as their mission for defense could not succeed without an adequate airlift.

What I am proposing is that we add to our super-Sunday punch of the big bombs, a lightning-fast left of Civil Reserve Air Fleet, ready to fly anywhere in the world with trained crews on six hours' notice. While three-fourths of such a fleet could be working on civilian lines at no expense to the government other than the slight risk on the guarantee, one-fourth could be in the hands of MATS to be under their sole control for the earliest possible reaction to any emergency.

They could perfect their flight proficiency by actual exercise in troop movements and by flying outsized or explosive cargoes, or servicing routes not now served by regular airline routes. Today, 93% of military passenger traffic and 89% of all military cargo moves between areas served by regularly scheduled commercial carriers. Little battle training is gained by such procedures.

While the strengthening and balancing of our military posture is of vital importance, the effect upon the vast aviation industry is of great interest also. Today most of our air cargo moves at a rate of about 23 cents per ton mile. This is because we still carry freight in converted obsolete passenger aircraft, and costs of operation for freight are almost prohibitive except for cargo of highest values.

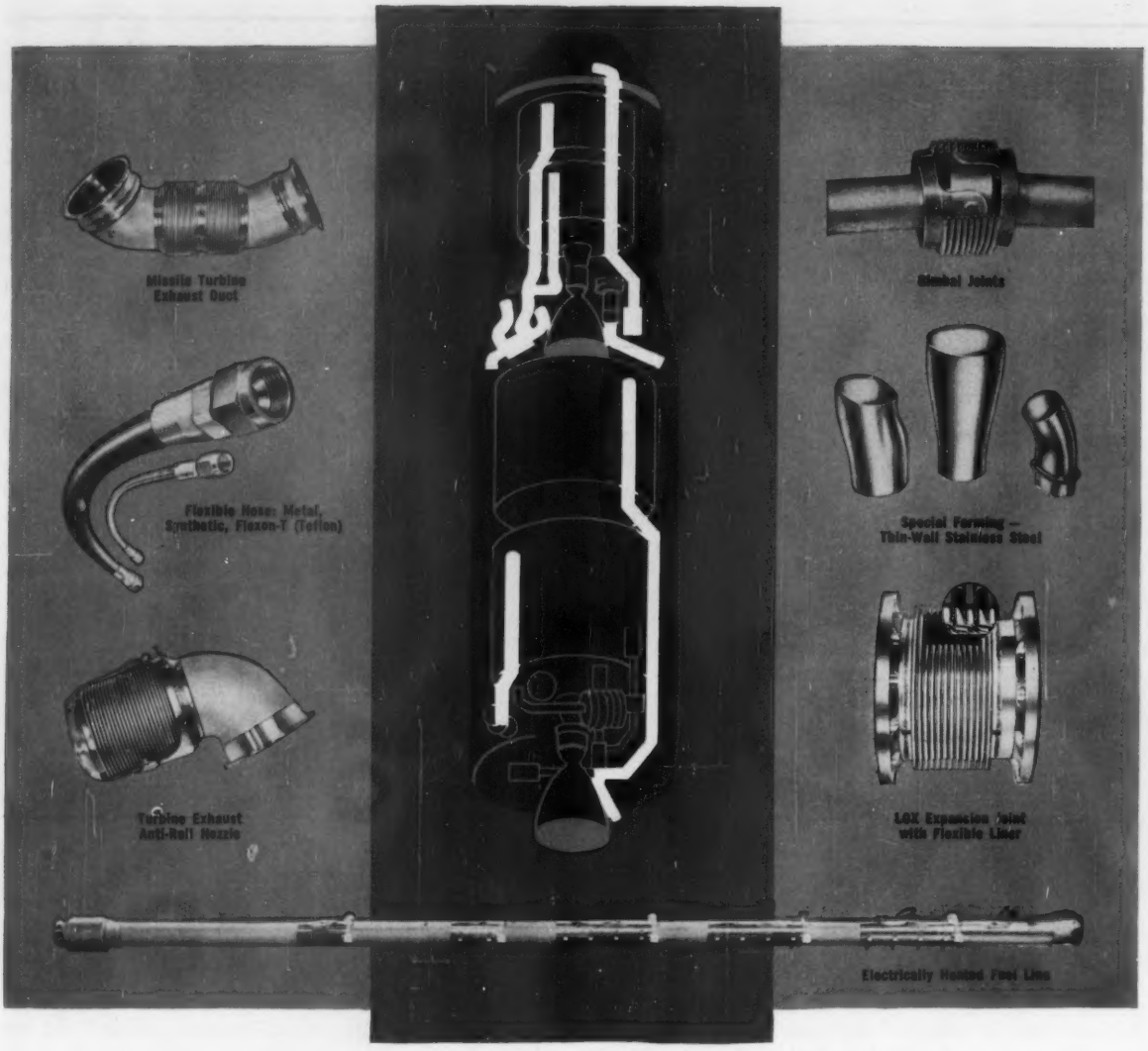
These new planes of which I speak have a direct operational cost of from 4 cents to 4½ cents per ton mile, which would make the commercial rate as low as 9 cents or 10 cents per ton mile—perhaps even lower. Thus a new era of air cargo would be opened. Hundreds of types of freight could then move at costs no more than 10% higher than truck freight rates.

This is the new frontier of aviation. This is the barrier we can break for our aviation progress as well as our military security. This will, in addition, relieve the threat that is upon the industry with the advent of the jet air age.

For example, the backload of orders for multi-motored aircraft today is 20% less than it was a year ago. In spite of scheduled airline traffic increasing by one-third since 1955, airline employment has increased by only one-sixth. This is because of larger planes, faster and less frequent schedules. . . .

The jets and their record traffic and record revenues in the first six months of 1959 produced a profit margin for the trunk airlines substantially below that produced by earlier aircraft in 1951, 1952, 1953, 1955 and 1956. Trunkline stocks ranked 45th out of 46 stock groups, with a gain of only 4.1% over their 1956-57 highs.

American aviation boasts distinguished bankers, financiers, lawyers, public relations personnel and traffic experts. Are there still within it 'aviators'—men to whom aviation is an adventure in growth and a challenge to the future? With the same vision that they had in earlier days, aviation can face the future with assurance that its greatest years lie ahead and not behind.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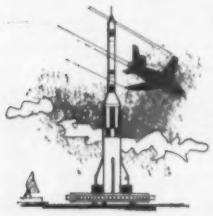

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Ralph J. Halk, vice president, Granger Associates, Palo Alto, Calif.

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Paul D. Arthur, vice president, Systems Corporation of America, Los Angeles, Calif.

Dr. Frank J. Willig, vice president-systems, Emerson Research Laboratories of Emerson Radio & Phonograph Corp., Silver Springs, Md.

Charles H. Webber, executive vice president, Pacific Scientific Co., Los Angeles, Calif.

John J. Burke, a vice president of the Siegler Corp., Anaheim, Calif., to coordinate the missile and space age activities of all divisions of the company.

Julius P. Ziegler, vice president and general manager, Amcel Propulsion, Inc., Asheville, N. C., an affiliate of Celanese Corporation of America.

Leigh A. Taylor, vice president-marketing, Southwestern Industrial Electronics Co., Houston, Tex., a division of Dresser Industries, Inc.

Louis Polk, assistant vice president and manager, Gaging and Automation Systems Divisions of the Sheffield Corp., a subsidiary of Bendix Aviation Corp., Dayton, Ohio.

Robert C. Green, Deputy Chief of the Technical Assistant Division, Office of International Coordination, Federal Aviation Agency, Washington, D. C. Also: **David S. Williamson,** Deputy Assistant Administrator for Plans and Requirements, FAA.

Col. Willis F. Chapman, Assistant for Foreign Developments, Deputy Chief of Staff, Development, Headquarters, USAF, Washington, D. C., replacing **Brig. Gen. Don Z. Zimmerman,** retired.

Patrick Duncan McTaggart-Cowan, Director of the Meteorological Branch, Department of Transport, Canada.

Honors and Elections

Collier Trophy Award for 1958 will be presented by the National Aeronautic Assn. to the USAF and industry team responsible for the F-104 Lockheed interceptor. The recipients are: **Clarence L. Johnson,** Lockheed Aircraft Corp., for design of the airframe; **Neil Burgess** and **Gerhard Neumann,** General Electric Co., for development of the J79 turbojet engine; **Lt. Col Howard C. Johnson,** USAF, for establishing a world land-plane altitude record of 91,243 ft., and **Maj. Walter W. Irwin,** USAF, for establishing a world straightaway speed record of 1,404.09 mph.

Brig. Gen. Benjamin S. Kelsey (USAF, ret.) has been appointed Visiting Jerome Clarke Hunsaker Professor of Aeronautical Engineering at the Massachusetts Institute of Technology for 1959-1960, and will deliver the annual Minta Martin Lecture on aviation next March.

(Continued on page 129)

INDUSTRY OBSERVER

► Minuteman solid-propellant missile system may be the first to incorporate newly developed self-adapting control system principles to modify its re-entry trajectory. New self-adapting principles also are being applied to communication systems by General Electric, which is designing a receiver that automatically adjusts its bandwidth and other characteristics as propagation conditions change in order to optimize performance.

► **First firing of Samos-type advanced reconnaissance system vehicle in Air Force's WS-117L program is scheduled to be made in December from Cape Canaveral, Fla., a month earlier than originally projected (AW May 25, p. 26). Vehicle will be composed of a Convair Atlas as the booster plus a Bell Hustler liquid-propellant engine fitted with enlarged propellant tanks.**

► Present projections anticipate more than 20 additional launchings of Discoverer polar-orbit satellites from Vandenberg AFB, Calif., by the Advanced Research Projects Agency. Frequency is expected to eventually reach two firings per month in the program that thus far has dragged considerably behind its original timetable.

► **Navy Bureau of Weapons has a requirement ready for a new carrier-based 50,000-lb.-gross aircraft to carry its long-range Eagle air-to-air missile but is withholding its distribution to industry, probably because of the problem of money required to fund the project and the time requirements needed to develop a new aircraft that can match the Eagle's timetable. Consideration also is being given to possible conversion of the 70,000-lb. Douglas A3D as a substitute aircraft.**

► Aerojet-General is scheduled to deliver a total of 15 AJ10-118 liquid-propellant engines for second-stage use in a series of 12 Thor Delta space-probe vehicles Douglas Aircraft Co. is building for the National Aeronautics and Space Administration, indicating that at least three of the engines will be held on a standby basis. Douglas received the first Aerojet engine in August, and the second is now ready for delivery, although the first Delta is not scheduled for firing before early next year. Aerojet contract is for approximately $8 million.

► **Latest report on Army's Mauler air defense missile is that Army now believes it has sufficient funds to award a contract for the second phase of development, probably by early 1960. As recently as two weeks ago, it appeared there would not be sufficient Fiscal 1960 funds to award a contract for the on-again, off-again program.**

► Watch for probable British purchase of 30 Dornier 27 STOL aircraft from Dornier Werke GmbH, Munich. Aircraft was recently demonstrated in England to the military, and the company is now negotiating terms of an order with the British. Some observers regard the order as a hopeful British attempt to ensure future German purchases of the former's heavy transport aircraft.

► **Fifth Douglas Thor IRBM squadron originally scheduled to be held on reserve status at Norton AFB, Calif. (AW Oct. 12, p. 23) is being canceled by the Air Force. Approximately 90% of the ground support equipment for the squadron already has been procured. Four Thor squadrons have been allocated to Britain's Project Emily.**

► Naval Research Laboratory is studying the use of infrared for undersea detection. Hour-old wakes of undersea vehicles have been detected but little success has been achieved against submarines at rest and operating on low wattage.

► **General Precision Laboratory expects to deliver the first elements of its semiautomatic traffic control data processing system to Federal Aviation Agency within the next few weeks, but full system delivery is not expected until early next year. System will be installed at FAA's National Aviation Facilities Experimental Center in Atlantic City for trial. Program has fallen about a year behind its original 12-month delivery timetable which was recognized at the time as being a tight schedule.**

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Washington Roundup

Best Wishes

Here's what Dr. Wernher von Braun, director of the Development Operations Division at Army Ballistic Missile Agency, had to say about the marriage of his missile team with National Aeronautics and Space Administration (see p. 28) one day before the wedding was announced:

"For most of the country October is the month of the World Series, college football, new automobiles and Halloween. Down in Huntsville, Ala., we have a unique local custom which is traditionally observed after the cotton and corn have been harvested.

"It is a kind of wedding rite, though in recent years we have had to face up to the question of which wedding is right.

"When fall arrives, we journey down to the courthouse to pay our taxes, buy our license plates and hunting permits, and then wait. Wait, that is, for someone to decide whether we continue in our present marital relationship with the U. S. Army or embrace a new bridegroom.

"We have not sued for divorce. In fact, we have become quite fond of our present spouse who has carried us through famine and problems for 14 long years. As it is with any reasonably successful marriage, we have become accustomed to each other. While sometimes, when the going is rough or the paperwork overwhelming, it may not be passionate love, there is at least a mutual bond of respect and affection linking us.

"I believe it was Emerson who stated the problem in these terms, 'Is not marriage an open question, when it is alleged, from the beginning of the world, that such as are in the institution wish to get out and such as are out wish to get in?'

"It is nice to be courted, of course. It is reassuring to know that benign godparents are looking out after our interests. We hope, rather wistfully, that we won't be left waiting at the altar.

"Our mayor in Huntsville, Spec Searcy, dusts off a familiar motto each fall, possibly as a kind of reminder. It's the one about the fellow who made a mouse trap at his home in the deep woods, where he tried to escape fame and the tax collector, only to have the world beat a path to his door.

"We haven't asked anyone to beat a path. We have arranged nonstop air service between Washington and Huntsville to make it easier to locate us! Meanwhile, we do a little dove hunting, we build a few rockets, we listen to the radio dispatches from Moscow, and we wait."

Soviet Nuclear Plane Progress

Rep. Melvin Price (D.-Ill.), chairman of the research and development subcommittee of the Joint Congressional Committee on Atomic Energy, last week reported the results of an interview with V. S. Yemelyanov, the Soviet atomic expert who accompanied Premier Nikita Khrushchev on his recent U. S. tour.

Price said:

"Relative to the application of nuclear power for aircraft propulsion, Yemelyanov stated that the USSR is working on such a project 'because it is considered a worthwhile development.' He stated that when the USSR obtains technical knowledge from its work the results will be published.

"Yemelyanov expressed confidence in the success of the USSR's work in the development of nuclear aircraft. He said 'We will have success because we don't try anything that isn't a success!' "

Soviet 'Munitions Lobby' Charge

A segment of the Soviet press is using comments made by President Eisenhower and in Congress during the past session to substantiate its charges that a "munitions lobby" influences U. S. defense spending and wants to keep the U. S. in the arms business. Recent statements in the Soviet press include:

- **"What is the explanation** for this high demand for former high-ranking officers? In the words of a member of the U. S. House of Representatives, the companies which hire retired generals and admirals do so with the avowed intention of using their influence in military circles." The reference is apparently to statements made by Rep. Alfred Santangelo (D.-N. Y.).
- **"According to (Rep. Carl) Vinson,** chairman of the House Armed Services Committee, 94% of all military orders are not distributed on the basis of open competitive bids but through secret agreed prices. Thus the interest of industrial concerns in influential retired military men is understandable."
- **". . . the U. S. President . . . complained** about the lobbying by armament industrialists to increase armament expenditures. Cannon (Rep. Clarence), chairman of the House Appropriations Committee, openly stated . . . 'We would not be spending nearly as much money if it were not for supply officers and armament industrialists. If we were to proclaim peace, they would go bankrupt.' "

Khrushchev's Helicopters

Three Sikorsky S-58 helicopters for Chairman Nikita Khrushchev—with all the trimmings to make them identical with the helicopter used by President Eisenhower (AW Oct. 19, p. 25)—will cost over $1 million. Cost of the standard commercial version is $267,000 each. United Aircraft Export Corp. was scheduled to submit its detailed proposal—including exact price, terms of pay, delivery dates, specifications for crating, spares, etc.—to the Soviet Embassy late last week.

Latin Unity

The movement toward unification of Latin American air operations took a step forward at the recent meeting in Montevideo of legal representatives of Argentina, Brazil, Venezuela and Uruguay.

Agreements reached by representatives of the four countries included:

- **A comparative study of aviation laws** in the various Latin American countries should be undertaken with an eye toward making them uniform.
- **A study should be made to determine** ways and means of modifying present laws to promote the flow of traffic from country to country and the development of aviation in the region.

The representatives also recommended to the governments of Latin America that they enter "regional pacts" for "the defense of their common interests." Preliminary steps already have been taken toward the possible integration of operations or merger of some Latin American airlines (AW Sept. 21, p. 25).

—Washington staff

Space Technology

NASA Gains Army Missile Team, Saturn

ABMA research group, booster project transferred from military; Gen. Medaris, Johnson to retire.

By Evert Clark

Washington—Future of Army Ballistic Missile Agency's research and development team, which has been in doubt for more than a year, was settled last week when President Eisenhower ordered both the team and the 1.5-million-lb. thrust Saturn space booster transferred from Defense Department to the National Aeronautics and Space Administration. The team also will have at least nominal technical direction over the nation's other super-booster, NASA's 1.5-million lb. Nova single-chamber engine.

The President's order followed the resignation of Roy W. Johnson as director of Defense's Advanced Research Projects Agency (see p. 30), the retirement of Maj. Gen. John B. Medaris as commander of the Army Ordnance Missile Command and strong criticism by Dr. Wernher von Braun on the pace at which the nation's space programs have been moving.

Von Braun and a group of German-born scientists who developed the V-2 rocket have been the backbone of Army's missile work for the past 14 years.

Diminished Role

The White House said the transfer essentially takes the Army out of the space field. Army's role was considerably diminished recently when Defense announced that Air Force would handle the launching of the Army-developed Saturn and all other space boosters (AW Sept. 28, p. 27). Army feared that if development responsibility for Saturn also was transferred to the Air Force both the booster and the development team might be in jeopardy (AW Oct. 5, p. 26).

Settlement of the future of both the team and the booster had been expected in the near future. But growing criticism of the U.S. position in space versus that of Soviet Russia, climaxed by the Johnson, Medaris and von Braun events, apparently accelerated the making of the decision.

Announcement of the President's order followed a meeting at the White House attended by Defense Secretary Neil McElroy and his deputy, Thomas S. Gates; Defense Director of Research and Engineering Herbert York; T. Keith Glennan, NASA administrator, and his deputy, Dr. Hugh L. Dryden; Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff; Dr. George Kistiakowsky, presidential science adviser; Elmer Staats, acting director of the Bureau of the Budget; Maj. Gen. Wilton B. Persons and Brig. Gen. Andrew J. Goodpaster, presidential assistants, and Press Secretary James Hagerty.

President, Brucker Meet

Army Secretary Wilber M. Brucker arrived at the White House before the conference ended but met separately with the President later. The White House said the meeting had been planned long before the Johnson and Medaris resignations and the von Braun criticism became public knowledge, but there were strong indications that the President originally had not planned to consider the ABMA and Saturn problems until a National Aeronautics and Space Council meeting late this week.

The morning before the meeting, von Braun had made perhaps the strongest criticism of U.S. space progress made by anyone directly connected with the program since the first flurry of excitement that followed the launching of Sputnik I. Speaking in Washington from a text that had had even stronger passages deleted by the Army, von Braun said that "instead of wasting time and energy in ponderous reappraisals and re-examinations we ought to pitch in to get the show on the road and get into space."

His Saturn project has just undergone a reappraisal in which cancellation was considered in an attempt to save funds in the Fiscal 1961 budget. Transfer of the ABMA team was under reappraisal at the time he spoke, and he criticized the "waiting" necessitated by this (see p. 27).

"How soon Saturn becomes available to bring us closer to a position of parity with the competition depends to a very great extent upon the resources committed to the program," von Braun said. "It is moving ahead. It could move faster . . ."

Both von Braun and Gen. Medaris said the latter's resignation two and a half years ahead of his compulsory retirement age was not a protest resignation.

But both men made it clear from their remarks that Medaris was no more pleased with the pace of the space effort than von Braun was.

Prior to the President's decision, vo

Saturn Funding

Washington—Double the current funding for the Saturn 1.5-million lb. thrust space booster will be asked in the Fiscal 1961 budget unless the impending transfer of the work to the civilian space agency changes this figure. Plans for upper stages for the Saturn vehicle are currently being revamped.

Prior to last week's announcement that the booster and the Army Ballistic Missile Agency team developing it would be transferred to National Aeronautics and Space Administration, a request of $135 million for Fiscal 1961 was planned. This figure apparently already took the transfer into account.

Defense Department's Advanced Research Projects Agency initiated the project with ABMA to give the U. S. its first large space booster beyond those based on ballistic missiles. Army asked $127 million for Fiscal 1960 and got only $50 million. This later was increased to $70 million. Army wanted $250 million for the next fiscal year, but the figure planned for inclusion in the next budget stood last week at $135 million.

Saturn is a cluster of eight Rocketdyne engines, rated at 188,000 lb. thrust each, and nine interconnected tanks. With suitable upper stages, it could place a 15-ton satellite into an earth orbit, send 7,000 lb. into deep space, soft-land a ton on the moon or send a crew of spacemen around the moon and back to earth. Loss of one engine in the cluster would cut orbital payload capability by only 3 to 4%.

Initial goal was to static test the cluster last September and make the first flight test in 1960. Fabrication of four of the outer fuel tanks is now being completed at ABMA and fabrication of the liquid oxygen tank is about two-thirds completed. Static test probably cannot come before early next year, with the flight test following about a year later.

Upper stages at one time were to have been the Martin Titan-C, a four-engine version of the Titan intercontinental missile first stage; and the Convair Centaur. This is now undergoing re-evaluation.

Braun denied reports that he also would resign. He said he would stay on as long as the team he headed was given challenging space projects. Both men criticized the lack of decision in Washington but declined to lay the blame on any individual.

The night before the President's meeting, von Braun spoke again in Louisville, Ky. His remarks this time were still critical, and even more critical phrases and paragraphs had been deleted from his text at the Army's request. He told the Louisville audience:

"Every once in a while, of course, the Russians touch off another space rocket," von Braun said. "Each time a Sputnik or a Lunik is announced, there is a short-lived flurry but the despairing fact is that the flurry becomes smaller and shorter.

'Quixotic World'

"One is forced to conclude that the public at large doesn't care or that the public thinks, like Don Quixote, that this is the best of all possible worlds and that we're coming out all right in the end . . .

"I sometimes hear talk that maybe the Russians have bigger rockets but ours are smarter. I think this is dangerous twaddle. It would offer little comfort to the fellow living in the target area of an ICBM. It is not at all reassuring to the fellow living elsewhere in the world who is faced with the life and death question of which side is right."

Similar criticism, voiced in milder terms, has been made recently by officials of both Defense and NASA. Privately, a number of officials in the space program have spoken as strongly as von Braun did publicly.

After the transfer of his design team was announced, however, von Braun declared that "the major concern of my colleagues and myself is that we be permitted to continue to devote ourselves to this country's space efforts." He added that "the President has decided that it was in the best interests of the country that our work be done within the framework of NASA in a progressive space program which will make this nation second to none."

Medaris, who leaves office next Jan. 31, said he was "pleased and relieved" by the transfer decision.

Major considerations in the transfer of Saturn to the civilian space agency apparently were the election year budget and the nation's foreign policy. Thinking on Saturn has included from time to time possible military missions, but the tight budgets expected for next year have tended to convince Pentagon officials that presently-planned military missile boosters will be adequate for the near future and that this high-cost project would fare better if it were competing for civilian funds.

There also has been growing feeling within the Administration that for the sake of public appearances, if for no other reason, hardware that will be used for what essentially is psychological warfare should bear the civilian label wherever possible.

Transfer of the Army missile team will be presented to the next session of Congress as a reorganization plan and will take effect 60 days later unless either body raises strong objections. Although Congress can be expected to air the matter thoroughly, Army apparently has given some assurance that it will not attempt to block the transfer. NASA asked for ABMA a year ago but lost out because of Army and congressional opposition.

Effect of Transfer

The transfer is expected to affect most of the 4,200 civilians and the handful of Army personnel in ABMA's Development Operations Division which von Braun heads. It includes 10 research and development laboratories, one of which is the Missile Firing Laboratory which conducts ABMA launchings from the Air Force Missile Test Center.

Some 2,000 personnel in the industrial, field support and training divisions of ABMA are not directly affected by the transfer but, since their function is chiefly one of support for the development division, some rearrangement must be made. ABMA's physical plant is valued at about $75 million.

Because Army missile work has been dwindling since the Thor Jupiter decision many months ago and because ABMA's fabrication laboratory always has had a low volume of production, overhead of supporting the number of personnel there has been high. This was a major consideration in canceling Jupiter boosters out of the Mercury program and will be one of the first problems NASA must tackle. ABMA's Fiscal 1960 budget is $445,885,000 as opposed to NASA's $500,200,000.

Precise relationship of the Army group to the Nova booster project was not clear last week. This 1.5-million lb. booster is being developed by Rocketdyne Division of North American Aviation, Inc., with NASA funds.

President Eisenhower said that as part of his action, "development of 'super booster' special vehicles will be consolidated in NASA under the immediate direction of this (Army) team. I have directed that this program be vigorously pressed forward." NASA spokesmen said immediately after the announcement that the statement apparently was intended to include Nova.

ABMA currently is phasing out its work on the Jupiter intermediate range missile for Air Force, is working on the 500-750 mi. range Army Pershing missile and is doing some work for ARPA and NASA aside from Saturn.

NASA Administrator Glennan said a team of specialists will work out details of the transfer. He said NASA is "most fortunate" to obtain the Army scientists and engineers, who have "earned a world-wide reputation for excellence in their field and have become a national asset."

President Eisenhower said the team "has demonstrated its intense dedication in this field and has shown its high technical proficiency through splendid accomplishments under Army agencies. The contemplated transfer provides new opportunity for them to contribute their special capabilities directly to the expanding civilian space program."

Douglas Records Loss

Los Angeles—Douglas Aircraft Co. showed a net loss of $25.7 million or $6.73 a share for the first nine months of the company fiscal year. The board of directors has taken no action on a quarterly dividend.

Sales to the end of the third quarter were $658 million. Company backlog was $1,334,437,000. Development costs on the DC-8 turbojet transport for the nine months were $27.6 million, and inventory writeoffs were $36.8 million.

Lunar Probe Cloud

London—Second Soviet lunar probe apparently produced a cloud of dust and gas 300 to 560 mi. high when it struck the moon last Sept. 13. Moscow radio broadcasts received here quoted Dr. Kyril Stanyukovich and another scientist as saying some observers saw the cloud and others observed the shadow. Velocity at impact should have been 1.5 mi. per second, they said. If the probe hit a dust bowl, the crater should have been about 140 yd. wide. If it hit a rock mass, the crater might be no larger than 16 yd. in diameter, the Soviets said.

Italian Space Effort

Milan—Possibility of closer collaboration between Italian and U. S. scientists in space research fields was recently discussed here by Dr. Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, and members of the newly formed Commission for Space Research of the Italian National Research Council. The seven-man commission, charged with accelerating Italy's work in space research, is headed by Luigi Broglio, University of Rome professor of aircraft construction.

Johnson Retires, Outlines ARPA Future

By Craig Lewis

Washington—Roy W. Johnson will leave his job as head of the Advanced Research Projects Agency before the end of the year but expects ARPA to continue to exist in the pattern established under his direction.

Leaving ARPA after 21 critical and controversial months in charge of the military space effort and advanced research, Johnson told AVIATION WEEK that his departure conforms with plans he laid down when he took the job. He said he originally had expected to leave within 18 months but that, when the deadline arrived in July, he discussed the matter with Defense Secretary Neil McElroy and agreed to remain through the transitional period when the groundwork was being laid to shift space programs back to the military services.

Johnson, who will leave ARPA within the next few weeks, says he plans to devote his time to the study of fine arts and the development of the artistic hobby he has followed for 20 years. He says he has no plans to return to industry, although he doesn't bar such a prospect if something particularly "intriguing" should be offered.

Johnson said that the choice of a successor is the only thing keeping him in the Pentagon. He hopes to have the issue settled by Thanksgiving, and he expects to be gone by Christmas. Search for a successor is largely being conducted outside the Department of Defense, he said.

ARPA Future

Johnson said the Defense Department is looking for someone with the "experience and broad gage" to lead ARPA to "new heights and new growth." He said McElroy definitely wants to maintain the posture and status of the agency and that the new director will have the same access to the Secretary of Defense that he has had.

New director will take over an agency that is in a period of transition from managing the military space program to the simpler, less controversial task of conducting advanced research programs. This research function has always been cited as the basic purpose of ARPA, but the heavily budgeted space programs have obscured it in the past.

Johnson points out that this transition probably will require a full three years to complete and that ARPA probably will still have about half its space programs a year from now. Although four space programs were assigned to the services last month (AW Sept. 28, p. 27), none of them has been actually transferred. ARPA is preparing the total military space budget for Fiscal 1961 and will defend the budget before Congress.

ARPA was established in the confused aftermath of the first Russian satellite launchings two years ago. It was to be a single manager for research on "upstream" military systems which were to be turned over to the services when they reached an appropriate stage of development. But ARPA also was given responsibility for the nation's space programs until a permanent management pattern was established, and the agency became known as the military space agency. The name stuck, despite protests at various times that it was an advanced research group only temporarily in the space business.

Johnson left General Electric Co., where he had worked in advertising and directed appliance and electronics activities, in February, 1958, to become ARPA's director. The agency was conceived as a small management group which would use the technical services of a relatively small group from the Institute of Defense Analysis.

Johnson calls ARPA a unique management concept in government. Under this concept, the agency maintains a minimum in-house capability and has resisted opportunities to acquire facilities, laboratories or personnel from other groups. He describes the agency as a "free-wheeling, competent technical management group" which is maintained on a rotational basis.

This rotational scheme is a basic facet of the relationship with IDA. Industry lends its personnel to IDA for work under ARPA for periods of one or two years. Since it is a private organization, IDA can pay higher salaries than ARPA, and industry personnel suffer no financial loss during their IDA-ARPA tour.

Johnson points out that no conflict of interest arises because IDA men stay out of business which concerns their own companies. He said this is a "way of life" that is working very well, and he feels ARPA is "over the hump" with this management doctrine. ARPA has not reached its original goal of 100 technical men, and Johnson says he hopes it never does—he favors a "lean organization."

To Johnson, the prime advantage of the rotational approach is that ARPA can change its skills with shifting needs. As personnel are rotated, unnecessary skills can be thinned out and new skills acquired to meet new requirements. ARPA is currently building up in the electronics and chemistry areas as they become more important in the budgeted programs. As the role in space technology declines over the next three years, space specialists will be replaced with new skills.

Without an in-house capability for actual research and lacking a large permanent staff, ARPA does not have to build layers of new skills over old ones in order to meet new situations.

Johnson told AVIATION WEEK this concept can be applied elsewhere in government and that he firmly believes government should contract for as much work as possible. He points out that in-house capability frequently inhibits freedom of ideas and the ability to move quickly. He also observed that a department with a large permanent staff is slow to abandon old concepts, that it is difficult to fire people and that new layers of people are inevitably added to meet new situations.

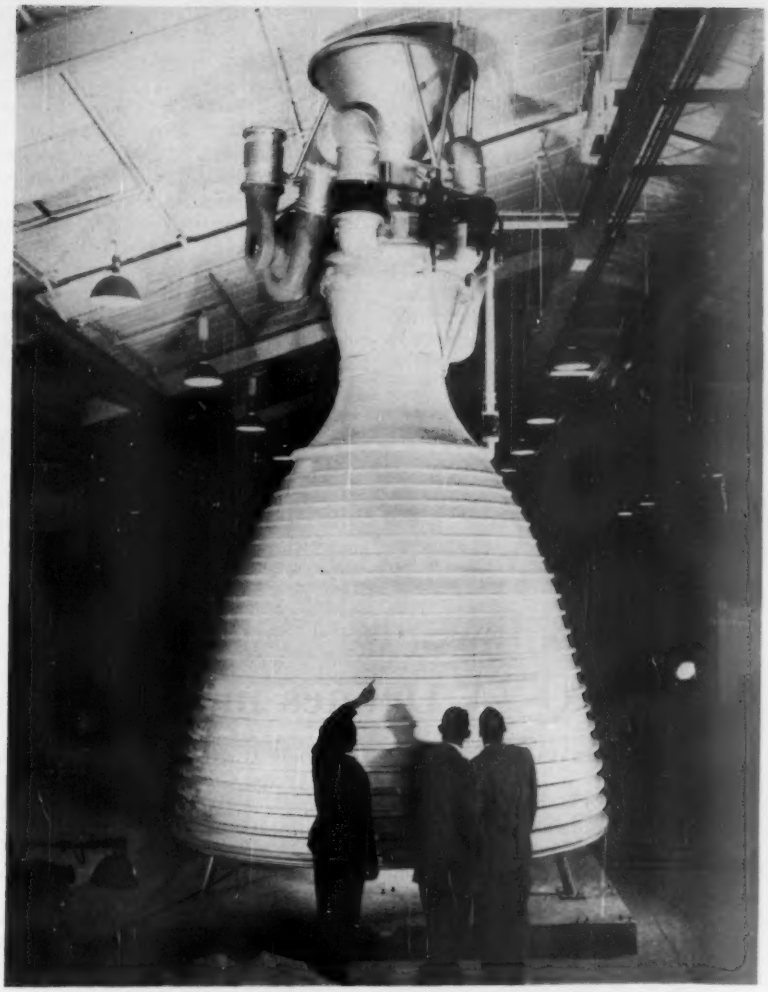
Same Approach

The same approach applies to industry, in Johnson's view. A company normally changes advertising agencies quickly and easily whenever its needs shift, and Johnson says this concept of outside contracting can work just as well in other areas—such as design and fundamental research. He also believes industry should do more contracting with foreign laboratories and universities, as ARPA does.

Johnson says ARPA went to work on the space program with the management approach. The general pattern was to use the services as contractors and agents, and several space systems were planned or developed under this system. Explorer IV was the first project to be completed successfully, and a number of programs were launched which later were passed to the National Aeronautics and Space Administration, including the Vega and Centaur boosters and the Pioneer moon probes.

Johnson concedes that ARPA personnel on the working level might not have been too happy about turning projects they had started over to NASA, but he said he and NASA Administrator T. Keith Glennan had been able to resolve all difficulties and that there is continuous communication and no trouble on the policy level.

Relations have not been so rosy with the military services. The services hotly resented having their space programs and prospects pre-empted by ARPA just as space work had become respectable. Six months ago, Air Research and Development Command-Chief Lt. Gen. Bernard A. Schriever said ARPA should be abolished, and the same recommendation has been made since by Dr. Clifford C. Furnas, former Assistant



1-2 Million lb. Thrust Rocket Mockup Built

Aerojet-General Corp. mockup at Sacramento, Calif., shows the size of a concept for a rocket engine capable of generating one to two million pounds thrust.

Defense Secretary for Research and Development.

A vivid demonstration of this conflict occurred in June, 1958, when Lt. Gen. Samuel E. Anderson revealed the schedule for the Pioneer moon shots. Johnson made it plain that announcing moon shot schedules was ARPA's business, and Gen. Anderson wound up with a reprimand from USAF Secretary James H. Douglas.

Johnson said service resentment of ARPA was understandable, if not helpful, but he believes the services now realize that ARPA played a significant role in establishing a military space program at a time when the White House and congressional enthusiasm was directed at peaceful approaches to space exploration.

He said ARPA successfully explained to Congress that space is an environment the military forces must use, and he feels that ARPA pulled together a military space program at a time when it could not be done any other way.

Along with this positive function of establishing and selling a military program, Johnson said ARPA also performed the valuable negative function of keeping the nation from investing large sums in "crackpot ideas."

When it was formed, ARPA offered the hopeful prospect of dampening the rivalries among the services for dominant space roles. Johnson doesn't think the agency has accomplished much along these lines thus far, and he blames this on the fact that ARPA was tagged from the beginning as the space agency. He feels, however, that ARPA could have a long-term impact in dampening these rivalries.

Congressional action in the months following establishment of ARPA produced two results to complicate the agency's originally simple role as master of U. S. space programs. One was the establishment of NASA, which eventually took the moon probes and other programs from ARPA, leaving the Pentagon agency with solely military space programs. The other was reorganization of the Defense Department.

This reorganization established a Defense Director of Research and Engineering. After a six month search, McElroy decided to give the job to Dr. Herbert York, who moved over from the post of ARPA chief scientist to become staff adviser and overseer of defense research and development programs. York must work through McElroy's office, but he has wide authority to coordinate and review all military research and development programs.

With this development, ARPA settled down to a role somewhat analogous to the three services. The agency gets its instructions and assignments directly from McElroy, as do the services, and it performs a line function in the research area. But York, a staff man, has authority to request review or changes in any ARPA or service research or development program, although he must act through McElroy.

Space Transition

Although ARPA's exit from space system management will be gradual over the next three years, it is nonetheless inevitable, and Johnson maintains that this was always the plan. He points to the assignment of Nike Zeus to the Army as the first indication of this policy. Nike Zeus assignment and budget were shifted to the Army when the system reached the point where it should become an integrated development program. Last month, this trend was accelerated by the assignment of four satellite programs to the services and by the announcement that USAF will be responsible for all military space booster programs.

This transitional period was launched last May when Johnson asked McElroy to get an opinion from the Joint Chiefs of Staff on which services should get the recently transferred satellites. McElroy endorsed the request, and he made the assignments after consulting with the Joint Chiefs.

Last month, McElroy sent a memorandum to USAF Gen. Nathan Twining, JCS chairman, telling him the time had come to start transferring ARPA space projects to the services and outlining the pattern to be followed. He said a joint military space operation organization is not desirable now and that it is simpler and more efficient to use the capabilities of the separate services.

McElroy told the Joint Chiefs that ARPA will continue to handle research and development up to the point of operational feasibility "for the time being" and that he will set a transfer

time for each project during its development phase. Assignments will be made on the basis of primary interest or special competence, but where these factors are absent, "consideration will be given to special competency in associate fields of development."

The Defense Secretary assigned responsibility for development, production and launching of space boosters and for associated systems integration to USAF "except for such research and development as may be conducted by ARPA." Other services will have to pay Air Force for the boosters they use in launching their assigned satellites. Before a service takes over a space vehicle or satellite program, it must submit a detailed plan for the system, including user relationships with unified and specified commands and other agencies. JCS will review these detailed plans.

McElroy said the director of Defense Research and Engineering will review and approve the detailed research and development programs in the space and satellite fields, using ARPA support where appropriate. He said particular attention should be given to incorporating more than one payload or system in a single satellite wherever practical.

Discussing U. S. competition with the Soviet Union, Johnson said U. S. military programs should not be measured in terms of equality with Russia in rocket engine thrust. He said this country has all the thrust it needs right now for military missions and that the Saturn clustered engine booster is funded to progress as fast as the military mission will require. Saturn was originally funded for $50 million in Fiscal 1960, but this figure has been raised to $70 million, and it will probably double in Fiscal 1961.

Johnson believes the U. S. must make an effort to win the technical propaganda war the Soviet Union has started, but he maintains that military budgets should not be involved in propaganda warfare. If ARPA and NASA are not chartered for propaganda purposes, some other means may have to be found to "win the battle for men's minds," but Johnson thinks the propaganda effort should be funded separately and not make use of money assigned and needed for military programs.

Johnson said that foreign aid serves little purpose if the people the U. S. helps are convinced this country is technologically inferior, and he suggested that some funds slated for foreign aid might profitably be diverted to an aggressive propaganda effort in order to make the remaining foreign aid expenditures a better investment.

After the space programs are transferred, ARPA will concentrate on its basic research role. An important element is the work in solid propellant chemistry designed to boost specific impulses at least 10-20%. Johnson calls this a "blue-sky program in which the fallout may be unpredictable" but said that the payoff can be "terrific" and that he is currently very optimistic. Program is budgeted for $18 million this year, and it probably will stay at about that level in Fiscal 1961.

Although it does not involve a specific space system, this solid propellant program is concerned with the space environment, and the same is true of the ballistic missile defense work ARPA is conducting to develop a successor to the Nike Zeus concept. The agency is spending $128 million on the project in the current fiscal period, and the budget will be higher next year.

The materials research program ARPA is launching is not in the current budget, but it probably will be started this year with emergency funds amounting to $15-17 million and will run between $15 and $20 million a year in the future. Johnson said present research is too fragmented, and ARPA wants to create an inter-disciplinary approach drawing on a number of related scientific areas. A competition is being held among U. S. universities, and four or five schools will be chosen for long-range programs. In some cases these programs will involve building laboratories, but after construction is completed, all the money will go for supporting salaries. ARPA hopes to develop a "couple hundred" extra doctors of philosophy in the field who will do their academic work in the materials laboratories.

For the future, Johnson points out that ARPA is a project agency and has no license to explore new areas without instruction from the Defense Secretary. He said the agency will do the jobs which are not being done by the services or which are issues of conflict among the services.

F-104s' Sidewinders Score Direct Hits on Q-2A Drones in Overcast

By James A. Fusca

Tyndall AFB, Fla.—Lockheed F-104 Starfighters have twice accomplished direct hits on target drones with Philco-General Electric GAR-8 Sidewinder infrared homing missiles fired in complete overcast here at the Air Force's William Tell weapons meet which has brought together for competition 12 fighter interceptor teams from bases around the world.

Success of the F-104 in completing interceptions with infrared missiles by direct hits and near misses on Ryan Q-2A 600 mph. Firebee drones through cloudy and heavily overcast weather appears to USAF observers to answer critics of infrared homing systems and to have demonstrated the potential of the F-104 as an air superiority day and night fighter.

The first week of the weapons meet has been carried on in the worst weather of any of the seven annual competitions and weather as bad as could normally be expected for actual air defense combat missions. Participating in the meet are 12 teams chosen by regional competitions. To score the combat potential of these teams on a relative basis they have been divided into three categories:

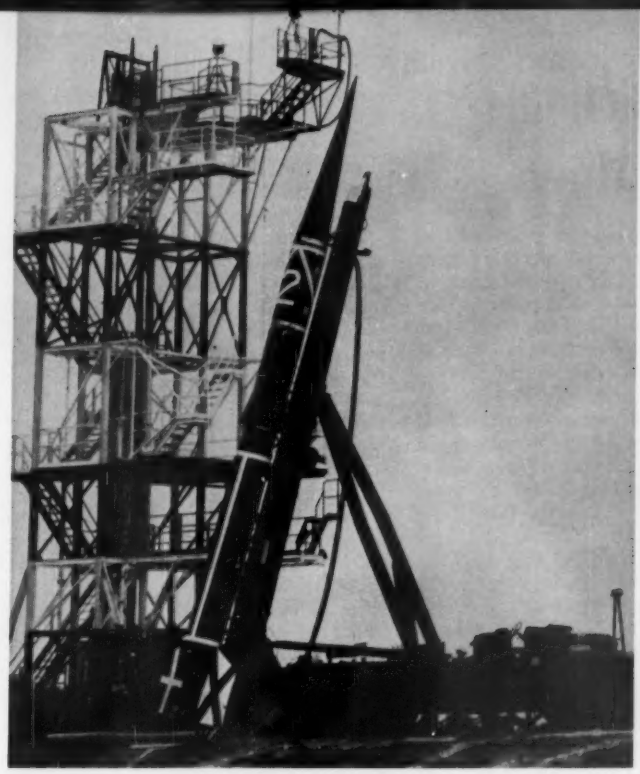
- **Three Northrop F-89J Scorpion** teams from Air Defense Command.
- **Six Convair F-102A Delta Dagger** teams, three from Air Defense Command and one each from the Pacific Air Force's Alaskan Air Command, and the U. S. Air Force in Europe.
- **Two F-104A Starfighter** teams from Air Defense Command and one North American F-100A Super Sabre team from the Air National Guard.

Highest scores in the meet through the first week have been made by the F-89J teams. One reason for this has been a fierce competition between the F-100A and F-104A teams marked by numerous protests on technicalities because their scores have run so close. Another reason is that the F-102A teams have fired in the worst weather.

Actual scoring for each team does not relate directly to the number of enemy aircraft that would have been destroyed on combat missions both because the aircraft are not firing their full combat load and because of some technical aspects of the scoring rules. For example, one F-102A team that was making up a previously aborted mission had its high score disqualified because, although the same two pilots and the same aircraft were flown, the pilots had switched aircraft.

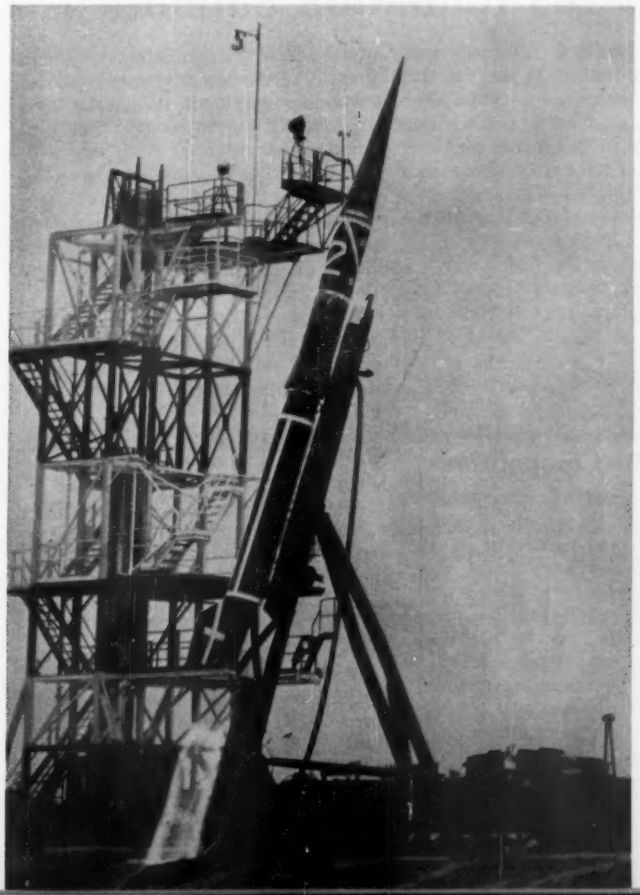
The four types of aircraft participating in the competition are firing four different missiles:

- **Douglas MB-1T missiles,** non-nuclear practice versions of the MB-1 Genie, are being launched by F-89Ls.
- **Hughes GAR-1D and GAR-2** Falcons are being fired by F-102As. The GAR-1D uses radar homing, the GAR-2 infrared homing. Both are equipped with a five-pound conventional explosive warhead with a contact fuze.
- **GAR-8 Sidewinders** are being launched by the F-100As and F-104As.



McDonnell Unveils ALBM Vehicle

Air-launched ballistic missile developed by McDonnell Aircraft Corp. is readied for an evaluation flight at Cape Canaveral. Missile was one of three test vehicles fired by company under an Air Force contract. Douglas Aircraft later was awarded the ALBM development work.



The two-stage, solid propellant missile is ignited and takes off from its comparatively simple, rail-type launcher. At present, company has no definite plans for future application of the hypersonic test vehicle.

Soviet Probe Completes Orbit; Photographs Farside of Moon

Washington—Soviet Union's third lunar probe passed some 25,000 mi. from the surface of the earth last week, completing its first full orbit and relaying to earth the information—including photographs—collected when it passed within 4,350 mi. of the moon last Oct. 6, according to the Soviets.

The 614-lb. payload reached a perigee of 25,557 mi. from the earth at 12:50 p. m. EDT on Oct. 18 at a point on the earth's surface above the Solomon Islands. It was moving from northwest to southeast and had a perigee velocity of approximately 8,746 mph., the Soviets reported.

The probe was to transmit again on Oct. 21 from a distance of approximately 203,197 mi. from earth, at which time it was expected to be over a point on the earth's surface at 38 E. longitude and 23 S. latitude over southern Africa.

An announcement on Oct. 19 was the first official admission that a part of the probe's mission was to photograph the unknown side of the moon. Apparently leaving an escape clause in case the attempt at photography was not successful, the official announcements said only that "the result of the processing" of "data of the scientific measurements and photographs" would be published.

Period of the probe's orbit for the first revolution apparently was about 14.6 days, but Soviet scientists hoped to photograph the probe near its perigee, when it would have the visibility of a star of the 12th magnitude, in order to predict future orbits. Before perigee was reached, Soviet predictions said the probe might make a close approach to the moon again in January, 1967, coming no farther than 6,214 mi. away. Ariy Shternfeld, winner of Russia's international prize for the promotion of astronautics, calculated that the station would pass close enough to the moon to make "successful observations" on its ninth, 16th, 25th, 41st, 66th and 107th revolutions.

Shternfeld said the probe will range between 31,070 mi. and 80,782 mi. from the moon as it travels along its orbit. Average speed, he said, will be about that of the average speed of the moon in the moon's orbit, or about 2,287 mph.

There are some indications that the probe was fired over the north pole in a difficult retrograde shot that did not take advantage of the earth's rotation. Dr. Fred C. Jonah and John Swider, of Chance Vought Aircraft's Astronautics Division, calculated the probable launching trajectory from data released by the Russians and concluded that an over-the pole path was used, carrying the probe beneath the lunar orbit, up and over the orbit and back toward earth. They said that this trajectory would have given the probe a look at almost all of the unknown side.

The Soviet news agency Tass reported on Oct. 8 that the probe would move in a plane almost perpendicular to the lunar orbit. Dr. Gyorgy Kulin, head of the Hungarian astronomical commission, calculated the orbit from official announcements and concluded that the probe observed roughly three-quarters of the unknown side, according to Budapest reports.

Prof. Kyril Ogorodnikov was quoted by Moscow radio as saying that the probe's orbit is a very extended ellipse, approximately two and one-half times as long as it was broad, and that the distance from earth at perigee is little more than one-tenth the distance at apogee. Apogee of approximately 292,058 mi. was reached on Oct. 10, at which time its velocity was approximately 894.8 mph., according to Soviet reports.

Possibility that the probe eventually will re-enter the atmosphere or impact on the moon has been discussed in Russian broadcasts, usually with emphasis on the amount of information it already has returned and could be expected to return before either of these happened.

"The radio transmitters of the rocket are expected to operate for a long time," according to the report quoting Ogorodnikov. "It is therefore called the Soviet automatic interplanetary station with full justice, for like the automatic stations in the ice of the Arctic, it is now carrying on a regular service, signaling to the earth about all the phenomena taking place in the boundless space of the cosmos."

An article in the magazine Soviet Russia discussing the probe's flight mentioned several methods of automatic control of rockets and indicated that the means used to control the lunar shots thus far has employed "a radiogoniometric station" that receives signals from the rocket continuously and feeds them into a computer which compares actual speed to required speed, allowing corrections to be made.

The article said "much use is also made of control obtained by the inclination of the motor . . ." A Moscow broadcast reported on a Soviet Russia article on rocket guidance systems by engineer Y. Asin saying that rocket-borne television would be used in any rocket landing on the moon to permit close control of trajectory.

GE Designs Radiation Satellite

Washington—National Aeronautics and Space Administration last week announced the award of a $536,000 contract to General Electric Co.'s Missile and Space Vehicle Department for development of a nuclear emulsion recovery vehicle (NERV) designed to obtain measurements of the Van Allen radiation belts.

Initial launches of the 75-lb. vehicle are scheduled to be made sometime next year, probably from the Pacific Missile Range, using an ARGO D-8 research rocket as a booster. The ARGO D-8 will boost the payload to an altitude of approximately 1,800 mi. Later, NASA's four-stage Scout rocket now under development may be used to send NERV to 10,000 mi. altitudes.

Heart of the experiment is a cylindrical disc one-half inch thick and three inches in diameter consisting of strips of radiation-sensitive nuclear emulsion materials manufactured by Ilford, Ltd., of England.

The disc will be exposed to the radiation fields at altitude ranges between 200 and 1,800 mi. by means of an electro-mechanically operated shutter.

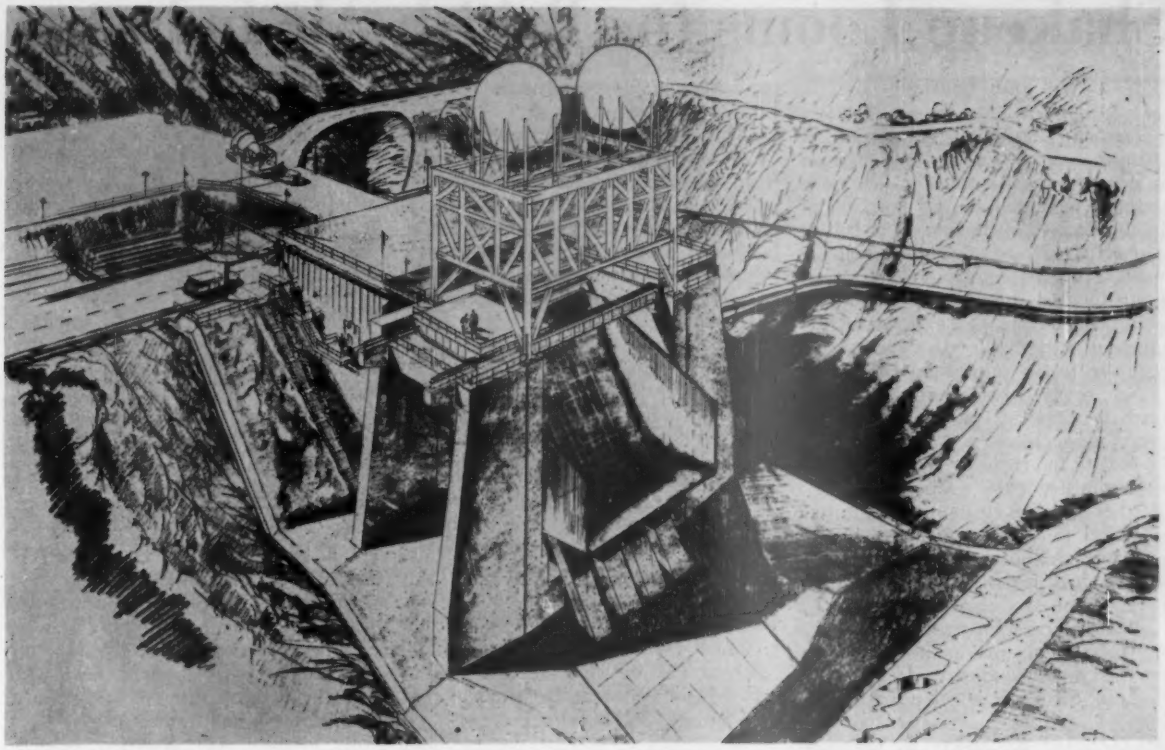
During the exposure, the disc will rotate behind a port in a shielded container.

After the vehicle has made its flight to maximum altitude and returned to an altitude of approximately 200 mi., the recovery system will be ejected, with a parachute opening at about 40,000 ft. In the ARGO D-8 flights, impact will be approximately 2,000 mi. from the launch site. The unit will be buoyant and equipped with electronic search beacons, flashing lights, radar chaff and a dye market to facilitate recovery.

Light Twin Competition

Navy has narrowed its evaluation of light twin aircraft to two—the Cessna 310 and Piper's new Aztec. The Aero Commander 500 and Beech Travel Air also were considered.

Support system similar to the one Cessna provides Air Force for its 310s (U-3A) through Cessna distributors, permitting USAF to eliminate stocking spares, will play a major role in the choice. Piper has offered to provide the same type system.



ARCHITECT'S DRAWING shows test stand 1-B, Edwards AFB, which is designed to test rocket engines of six million pounds thrust.

Edwards AFB Rocket Test Stand Designed for 6,000,000 lb. Thrust

Edwards AFB, Calif.—Six-million-pound thrust rocket engine test stand is scheduled to be completed here within one year. Known as stand 1-B, it will be able to accommodate a cluster of four 1½ million pound thrust F-1 rocket engines now being developed by North American Aviation's Rocketdyne Division for National Aeronautics and Space Administration (AW Aug. 31, p. 65).

Bid opening date by U. S. Army Corps of Engineers, Los Angeles, which is handling the project, is Nov. 5. Work is scheduled to be completed within 320 days after receipt of written notice to proceed. The project will cost about $5 million.

Test stand superstructure is topped by two large spherical tanks, one for RP-1 fuel, the other for liquid oxygen. Liquid oxygen tank will be tapped by a vacuum-insulated 6-in. pipeline. Other installations in the complex include fuel storage and distribution facilities, liquid nitrogen vaporizer, nitrogen bottles for supplying gas under pressure, support building, two observation stations, two water storage reservoir—one for 1,000,000 gal. and another for 400,000 gal.

Over-all height of the test stand will be about 120 ft., exclusive of superstructure. Width of the test stand's exhaust deflector apron is about 67 ft. Apron material will be steel. Below the end of the deflector apron, a dam at the bottom of a spillway will catch the cooling water from which fuel will be skimmed and water then recirculated for use again. The 1,000,000 gal. reservoir will feed into the test stand from a large pipe entering the test stand at the right. The 400,000 gal. reservoir will be used to store deluge water for general fire protection.

North American's Rocketdyne Division will be the user of the test stand. Architect and engineering services for the over-all project are being supplied by Aerojet-General Corp.'s Architect-Engineer Division, Covina, Calif., in association with Sverdrup and Parcel Engineering Co., San Francisco.

For operating economies and efficiency, test stand 1-B will be tied in with the existing test stand 1-A at Edwards AFB. Both facilities will use the same control room. Instrumentation cabling from stand 1-B will be carried to the control room through a tunnel. Fuel, liquid oxygen and nitrogen systems from stand 1-B will be tied in with the 1-A stand so that 1-B supplies can be used for existing stand 1-A. Also, stand 1-A's exhaust deflector apron, which is being converted to a wet installation, will be modified to receive cooling water from stand 1-B facilities.

Senate Group Urges Greater NATO Role

Washington – Senate Foreign Relations Committee is urging that North Atlantic Treaty Organization countries be given a larger hand in the research, development and production of military weapon systems.

A committee report based on a study made for the group by the Foreign Policy Research Institute of the University of Pennsylvania also proposed that:

- **Strategic-nuclear force** should be established by NATO, and be assigned the mission of defending Europe.
- **NATO should strengthen** its tactical nuclear and conventional forces to the point where Western Europe can be defended with or without nuclear weapons. It is estimated that NATO's present strength falls more than 10 divisions short of the established goal of 30 ready divisions.
- **USAF Strategic Air Command** forces should be increased to give them the capability of being rapidly deployed in Western Europe and elsewhere.

Shakeup Looms for British Air Industry

By John Tunstall

London—Creating of a ministry of aviation under a senior cabinet minister is seen as a direct outcome of the views recently presented to the government by the Council of the Society of British Aircraft Constructors. The council virtually defined minimal survival conditions for the industry in a six-point policy which demanded a "focus of government authority" as an essential prerequisite for its implementation.

No newly found enthusiasm for crash development programs on supersonic airliner projects is considered to lie behind the creation of the new aviation ministry (AW Oct. 19, p. 37). Neither does the creation of a ministry (in effect though not in name) of science and technology with responsibilities for space research mean any switch in the emphasis on space projects.

The aviation ministry and the minister have been unanimously welcome by the aircraft industry. It considers Duncan Sandys a ruthless, stubborn, but able decision maker who has fully demonstrated his ability to negotiate effectively with leading aircraft and defense personnel in the United States.

Sandys—Winston Churchill's son-in-law—has a political reputation going back to the mid-thirties for independent thinking and aggressive action. His past includes high positions in the war office and ministry of supply during the war, and the job of minister of supply from 1951-54 in the first postwar conservative government. In all his jobs—as in his recent tour as minister of defense—he has been entrusted with revolutionary changes needing forcefullness in pushing them through.

His work as minister of defense, which completely altered Britain's defense posture, has drawn reaction ranging from high praise to this comment in London's influential Observer: "In two years, he has sunk our ships, decimated our army, and grounded our air force, substituting for them a small stock of what are perhaps merely decorative bombs."

The industry has absolutely no idea what measures Sandys may begin to implement when his current fact-finding round of industrial conferences is over.

It admits that if he takes an adverse attitude he could be a distinctly difficult man to dislodge and his policy to unscramble.

The industry accepts that it is going to be decisively reshaped—and not by half measures. "It's stopped shrugging its shoulders, but might lend more than a hand," said one spokesman. "Good or bad, we are now waiting the opening blast."

The industry's requirements were made clear enough. The Council of the SBAC pressed for a six-point government policy to embrace:

- **Harmonization of service** transport aircraft requirements with those of civil airlines at home and abroad.
- **Extension of volume** of home market for aircraft.
- **Utilization of service** and state-owned airlines for operational development and proving of new aircraft and equipment—including items such as radar aids not specifically required by these two classes of operators but for other potential markets.
- **Better overseas sales** facilities.
- **Measures to expedite** specific research programs.
- **Defined financial** support from the government to ensure a continued place for the industry in the world.

This policy, AVIATION WEEK discovered, has the whole-hearted support of the industry, although companies emphasize different requirements.

Industrial sources quote two examples of what has been right, what wrong with the past. Both relate to the utilization of service and airline facilities in the proving of aircraft, and the harmonization of requirements.

The Bristol Britannia's problems, notably those of the Proteus turboprops, were clearly due to lack of proving facilities before it went into service. This engine developed novel icing problems in service. The company has barely broken even on the aircraft and now does not appear likely to sell many more. Only in recent months has the Britannia in modified form been bought by the RAF, long after the aircraft was proved in airline service.

The industry sees the perpetration of this folly again with the large Vickers VC-10 ordered by BOAC for service in 1963 and so far ignored by the services. Protracted negotiations with the Fairey Rotodyne fall in the same category.

On the other hand the intensive flight development of BOAC Comet IV RA.29 engines in the Transport Command Comet aircraft of the Royal Air Force illustrates what can be done and how it pays off. But for one seagull the Comet would have completed its first years service without a single unscheduled engine change (AW Oct. 19, p. 49).

The industry is quite capable of generating its own problems, too. An example is the present spectacle of Handley Page and the mighty Hawker Siddeley Group both newly competing in the DC-3 replacement field with virtually identical airframes and engines, not withstanding the existence of a fully established competitive aircraft, the Fokker Friendship. This situation is possibly redeemed by the fact that all three use versions of the same British engine.

The industry fears the price it may have to pay for the serious implementation of its six-point program is not just more regrouping into larger units. They fear that Sandys may press for a deeper financial integration of member companies within each group than is the current practice, which goes little farther than the pooling of research and production facilities. The present loose regrouping has proved unpalatable enough in the industry. Genuine mergers still appear unacceptable.

In some quarters it is admitted that it is not enough to form a loosely bonded group of small companies and call it a production entity. "A plethora of small units merely pooling research and development facilities does not meet present conditions imposed by fewer and larger aircraft getting more complex in a shrinking environment," as one prominent industry official puts it. The practice does nothing to scale up the physical size of individual facilities. It provides a multiplicity of small equipments such as presses and wind tunnels, when the real requirement is for single large items of equipment beyond the financial capacity of any single company.

The situation is obvious enough. But a large number of British companies are still dragging their heels on this issue, several of them doing very well. They

Riddle Cancels Argosy

Miami—Riddle Airlines last week canceled tentative plans to purchase four Argosy-Whitworth airfreighters as one in a series of economy moves planned by the company's new management.

Robert M. Hewitt, newly elected president of Riddle, said the airline was financially unable to firm its order or produce a cash deposit as stipulated in its letter of intent to purchase the aircraft.

Faced with heavy losses, which have ranged as high as $200,000 a month, Hewitt said the airline will undergo an extensive cost cutting program in an effort to eventually operate at a profit with its present fleet of Douglas DC-4s and C-46s. Hewitt added that the airline now has a surplus of aircraft that will be used for contract work or leased to other carriers.

include Handley Page, Blackburn and General Aircraft, Westland, Hunting, among the larger companies still entirely uncommitted. De Havilland and Fairey have formed a pool in respect of one aircraft; English Electric and Vickers are cooperating in respect of another.

When Sandys has marshaled his facts, how will he see this particular situation among the new family of problems he has collected? Will he subscribe to the view expressed in some aviation circles that unless the industry stops competing among themselves and realizes that singly it can do nothing it may later wake up to a situation where even collectively nothing can be done? Outside the industry many people are already suggesting the stable door has been shut after the horses have bolted.

In spite of the problems involved in it, the industry thinks Sandys will also make a more determined effort to improve Angle-American cooperation, leading at least to some coordination in the supersonic aircraft field, if not to any alleviation of the present heads-on struggle in large subsonic aircraft.

German Competition

Some companies regard the current American buildup of the German aircraft industry as one of the more harassing features of the industrys predicament. In this respect, the industry feels that the government could help the sorry present state of British overseas sales facilities in the missile and military aircraft field. It sights as its main difficulty the government's refusal to declassify performance details to the extent of American practice.

One authoritative industrial source told AVIATION WEEK that industrial and government elements in Germany are themselves divided on the economic wisdom of rejuvenating its aircraft industry. One school is known to hold the view that Germany should go all out to displace Britain as the world's third airpower, and should duplicate all British research and development facilities. Another school, believing that Germany cannot finance this project, maintains such duplication should be avoided and calls for collaboration with Britain.

On the invitation of the British government, a German delegation will visit Britain this month on a fact-finding tour of research and development installations. The SBAC hopes to impress this delegation with the full financial ramifications of duplicating the British research setup and of the political implications of getting it cheaply from the U.S.

In a statement issued a few days after his new appointment Sandys specified promotion of "the expansion of the British air services" as his special task along with strengthening "the structure of the British aircraft industry." Just what he will do is as much an unknown factor in the one as in the other. It's almost certain to include a greater role for the independent lines—something toward which the Conservative government has been steadily moving.

In the absence of its chairman at the IATA conference, a BOAC spokesman insisted that the corporation had no idea what immediate changes lay ahead. There could be no change at all in its aircraft procurement program which was irrevocably fixed up to 1963. For instance, he said, there could be no question of revoking the order for 15 Boeing 707 jets due for delivery next month—currently the most unpopular purchase BOAC has ever made.

"That order is signed" this spokesman said, "and in any case there is no British aircraft available able to cross the Atlantic nonstop both ways."

BOAC thought there was a possibility of some administration changes—"very minor ones"—and it might have to meet tougher competition from the independent airlines if they were given more freedom.

But before that competition could become effective on most of BOAC routes these independents first would have to be re-equipped. Nevertheless, this spokesman, pondering the fact that BOAC as a transport organization had been removed from the jurisdiction of the ministry of transport, said the "situation was certainly interesting."

But industrial sources outside the airlines see things getting much tougher, quite quickly for this airline which has been losing heavily each year. They predict significant staffing and administrative changes ahead.

"Almost everything that is wrong with BOAC could be put right by a vigorous pruning exercise" is how one authoritative industrial observer summed up the militant labor situation which has bedeviled the airline in recent years. The government, with an increased mandate and backed by Sandys' drive and ruthlessness, may now be prepared to face the inevitable consequences of further strike action.

Piper Development

Piper Aircraft's four-place, all-metal prototype Cherokee, under development at company's Vero Beach, Fla., plant, is expected to make its first flight soon. The low-wing Cherokee is reportedly the successor to the Tri-Pacer line, but it is still 12-18 months away from production. Still on the drawing board, in the design stage, is Piper's two-place Papoose.

News Digest

Civil Aeronautics Board examiner recommended last week that the $45 thrift fare between New York and San Juan, Puerto Rico, be retained by Trans Caribbean, Eastern and Pan American as a major generator of traffic in the long-haul market. The examiner, who said 210,000 passengers used the thrift service during the first six months of 1959, issued his findings in answer to complaints by Eastern and Pan American that the $45 rate is uneconomical and should be dropped. Fare was first instituted by Trans Caribbean in March, 1958, and later adopted by the two competing carriers.

ACF Industries is discussing possible sale or joint operation of its ACF Electronics Department with several electronic component companies (AW Aug. 24, p. 23; Sept. 14, p. 174.) The department, located in Alexandria, Va., was established to produce "Tinker-Toy" modules developed several years ago by National Bureau of Standards. ACF has decided not to renew its lease on Alexandria facilities which expires in January.

Boeing Airplane Co. last week proposed a turbofan, swing-tail cargo version of the 707 jet transport. The 735 cargoliner would be capable of carrying 100,000 lb. of cargo more than 3,000 mi. nonstop, Boeing said.

Grumman Aircraft Engineering Corp. has withdrawn its two appeals in the U.S. Tax Court protesting excessive profits determination by the Renegotiation Board totaling $8.5 million for 1951 and 1953.

Norair Division of Northrop Corp. has received a letter contract from USAF Air Materiel Command for 50 additional T-38A Talon jet trainers. Order provides for initial funding leading to production of the 50 aircraft and includes provisions for increasing Talon tooling production capability rate from two to 10 aircraft per month.

Erich E. Heiman, publisher and editor-in-chief of Interavia, monthly review of aviation and astronautics, died in Geneva, Switzerland, Oct. 17 at the age of 67.

Martin Co.'s Nuclear Division will test a liquid fluidized bed nuclear reactor, designed to reduce the cost of producing large-scale power, under an $838,163 contract from Atomic Energy Commission.

CAB Sets Rate for Expanded Mail Plan

Proposal could triple total return airlines now receive through expansion of experimental first-class plan.

By Ford Eastman

Washington—New rates proposed by the Civil Aeronautics Board for the expanded movement of first-class mail by air could more than triple the total return that the air carriers receive under the limited experimental program now in effect.

The rates set by the Board would give airlines approximately the same yield per ton mile as that received under the experimental plan. The total return, however, would be substantially boosted by the increase in the amount of first-class mail moved and the expansion of the air transportation of this mail.

The Post Office Department says it plans to initially expand movement of first-class mail by air to 76 additional pairs of points in the continental U. S., Alaska, Hawaii and Puerto Rico and to increase the amount to about 75,000 tons as compared with the 25,000 tons now moving by air (AW Oct. 19, p. 45). The program probably will be expanded by steps as the need arises.

Domestic trunklines under the experimental program receive an average of 19 cents a ton mile for the movement of this mail, while local service and intra-Hawaii carriers receive about 30 cents per ton mile. The previously existing rate to and from Alaska was 18 cents a ton mile.

Rate Determination

The new rates, prescribed in an order directing the Post Office and air carriers to show cause why they should not become final, were determined on the same basis as that used for the transportation of regular air mail but at one-half the amount. Compensation for each carrier is computed by adding line-haul charges and terminal charges, which is influenced by the number of miles involved in the haul and the size of the station of origin.

The Board said that, if notices of objection to the proposed rates are not filed by early this week, all parties shall be deemed to have waived the right to a hearing and all other procedural steps short of a final decision, and the CAB may then issue a final order fixing the rates as specified.

Under the order, each airline, regardless of whether it is a trunkline, local service or off-shore carrier, will receive a line-haul rate of 15.085 cents per mail ton mile for first class mail as compared with 30.17 cents per mail ton mile for air mail. This, multiplied by the number of miles, will determine the line-haul charge.

Terminal charge for each shipment of mail will be determined by the number of pounds involved multiplied by the rate prescribed for the station of origin. For Class A or largest stations, the terminal rate per pound is set at 1.66 cents as compared with 6.64 cents for air mail. Class C is 4.98 as compared with 9.96 cents. For Class B, the smallest station designation, the rate is 16.6 cents as compared with 33.21 cents for air mail.

Total Cost

Over long distances, this formula would increase the total cost of moving the mail a ton mile only slightly above the set line haul rate of 15.085 cents a ton mile, since terminal charges would be spread a greater number of miles. On shorter hauls, however, the cost of moving the mail a ton mile would be considerably higher than the line haul rate due to the smaller number of miles over which to spread terminal charges.

For example, mail moving from New York to Los Angeles, a distance of 2,474 mi., the proposed formula would give airlines a yield of 16.43 cents per mail ton mile as compared with the 15.085 cents line haul rate. From Washington to Chicago, however, a distance of 600 mi., airlines would receive a yield of 20.6 cents a mail ton mile.

In its order, the Board compared the proposed rates for first-class mail with the minimum freight rates prescribed by the Board earlier. For a flight of 1,300 mi.—average estimated haul for the initial increase in non-priority mail—the proposed rate would be 17.64 cents per ton mile for all sizes of shipments.

Minimum Freight Rate

The minimum freight rate for standard service is 20 cents for all shipments up to 1,538 lb. For larger shipments, the freight rate would decline. Still lower than standard service is the minimum directional freight rate, which is 11.48 cents, and the minimum freight rate for deferred service, 10.52 cents per ton mi. for a 2,000 lb. shipment over a 1,300 mi. haul.

Specific comparisons between first-class mail rates and freight rates charged for comparable commodities such as newspapers, magazines, and other printed matter are:

- **New York to Los Angeles,** a distance of 2,474 mi., standard service freight rate is 21.5 cents a ton mile, while the proposed mail rate is 16.4 cents.
- **Chicago to Los Angeles,** a distance of 1,751 mi., freight rate is 21.9 cents a ton mile, while the first-class mail rate is 17 cents.
- **Los Angeles to Seattle,** a distance of 957 mi., freight rate is 24.7 cents a ton mile, first-class mail rate 18.6 cents.
- **New York to Chicago,** a distance of 731 mi., freight rate is 22.2 cents a ton mile, first-class mail rate 19.6 cents.
- **Washington to Chicago,** a distance of 600 mi., freight rate is 22 cents, the mail rate 20.6 cents.

In arriving at the proposed rates, the Board listed a number of conditions and circumstances which it had used to support its earlier opinion and order in 1956 establishing rates for transportation of first-class mail on an experimental basis and which it said are still applicable now. They include:

- **That "the simplification of** handling procedures and the proffering of mail to carriers on a voluntary basis only to fill

Slick Orders CL-44s

Slick Airways signed a letter of intent to buy two Canadair CL-44D-4 turboprop swing tail cargo aircraft and has an option to buy four more.

Cost of the two airplanes with spares will be $10 million. Configuration is the same as the airplanes ordered by Seaboard & Western Airlines and Flying Tiger Line and the financing will be the same. Equipment trust certificates taken back by Canadair will be insured by the Canadian Export Insurance Corp.

Slick has dropped plans to buy six Lockheed Super Hercules cargo aircraft. Pan American also dropped its order for 12—both orders based on a military contract which did not materialize by a deadline last month—but Pan American still is interested in the airplane.

space that would otherwise be unused in no way interferes with other traffic, and thus places a minimum burden on the air carriers concerned.

• **"That the additional cost** of carrying mail is admittedly minimal—well below the 14 cents per ton-mile figure the hearing examiner used as a minimum in his range of costs.

• **"That the direct cost** of handling first-class mail is somewhat less than the cost of handling freight—in fact less than the cost of handling any particular kind of freight—and it would be reasonable to anticipate a rate for non-priority mail at a level as low as or lower than freight rates.

• **"That data submitted by** an all-cargo carrier indicates operating costs including a return element below the rates prescribed.

• **"That to assign a full share** of costs to a service designated and offered to reduce the cost burden imposed upon the primary services would be to ignore entirely the essential differences between a priority and a space-available service.

• **"That, where, within the range** below allocated costs but above added costs, the rates should fall is largely a matter of judgment to be exercised in the light of the peculiar circumstances of these cases.

• **"That the rates on newspapers,** magazines, and other periodicals corroborate the reasonableness of the rates fixed for first-class mail."

The Board added that, while it was satisfied as to the reasonableness of the rates proposed, it does not view these rates, or the rates ultimately adopted, as a result of this proceeding, as rates which will necessarily be effective for an extended period of time.

"We intend to keep this matter under surveillance," the Board said. "In the interim, the Postmaster General or the carriers can request revision of the rates at any time, and the Board may reopen them on its own initiative."

Northeast Lease Plan Approved by CAB

Washington — Civil Aeronautics Board last week approved plans by Northeast Airlines to lease Boeing 707-331 jet aircraft from Trans World Airlines for use on the former carrier's New York-Miami route this winter.

Board members said the lease agreement was approved because the CAB previously had permitted a similar lease arrangement between National and Pan American airlines, allowing National to use Pan American jets on the same route. Failure to grant the Northeast request, they said, would have placed the airline in an unfair competitive position this winter. Northeast expects to begin service with the jets Dec. 1.

CAB to Probe Air Credit Plans To Determine Cost to Airlines

Washington—Civil Aeronautics Board has ordered an investigation of air travel credit plans to determine just how they affect airline finances and charges to passengers.

Commenting that "we are in sympathy with the objectives of arrangements to convenience the traveling public and thereby provide a means of increasing air travel," the Board noted that it has never examined the various credit plans now in effect by carriers "nor has it passed upon the question of the reasonableness of the charges or the discriminatory aspects of the various plans . . ." It added:

"It appears that participation by the carriers in credit arrangements may result in additional costs to the carriers or deferral of the carriers' receipt of the fare for a significant period after the transportation has been furnished thereby extending to credit passengers the free use of funds during the period of credit. To the extent that participation in credit arrangements may result in an increased cost to the carrier not compensated for by the credit passenger, such credit provisions may have an adverse impact upon carrier earnings and consequently upon the fare level."

The Board order said its investigation will include:

• **Universal Air Travel Plan,** the airlines' own credit plan, under which a $425 deposit is made by the person, group or company in whose name the credit card is issued. The member, in turn, generally may issue an indefinite number of credit cards.

• **"Fly now, pay later"** plans, under which the passenger's fare is financed by a financial institution which levies an interest charge against the passenger. Losses are sustained by the institution.

• **"On-line" plans,** under which individual carriers issue credit cards for travel on their systems.

• **"Write your own ticket"** plans, variations of the "on-line" plans, under which ticket books are issued, so that the passenger can write out his own ticket and is saved the inconvenience of checking at the ticket counter.

• **Non-carrier credit plans.** Two carriers—Pacific Air Lines and Western Air Lines—have subscribed to the plans of Hilton Credit Corp. and Diners' Club, Inc., and honor the cards of these two organizations for air travel on their systems (AW Sept. 14, p. 40). The credit organizations assess the carriers a fee of approximately 8% for the business which comes their way through their credit cards.

Meanwhile, the Air Traffic Conference, which operates UATP, launched a major offensive to try and keep Hilton, Diners' or other credit organizations out of the air travel field by expanding its credit coverage to hotels, motels, and car rental agencies (AW Oct. 12, p. 48). The campaign to gain recognition of the UATP cards by these firms is being handled for ATC by Dickie-Raymond, a Boston advertising firm. Packets containing explanatory and promotional material and membership application blanks were mailed to 30,000 throughout the world last week.

ATC already has obtained membership subscriptions from one international and nine domestic chains representing 239 hotels and motels and Rent-a-Car with seven agencies in the U. S. and Canada.

The international chain, Intercontinental Hotel Corp., has 14 hotels in Latin America.

The domestic chains which have agreed to honor UATP credit cards are: National Hotel Co., with 27 hotels; Del E. Webb Motor Hotel Co, with 3; Best Western Motels, with 93; Western Hotels, Inc., with 26; Manger Hotels, with 11; Knott Hotels, with 24; Albert Pick Hotels, with 19; Albert Pick Motels, with 13; and Dinkler Hotels Co., with 4.

TWA Proposes Cut In Transatlantic Fare

Paris—Minimum round trip jet fare of $312 between New York and London is being considered by Trans World Airlines.

The proposal was outlined here by Robert E. Montgomery, TWA vice president-international sales before a meeting of the carrier's international district managers. It was understood the $312 tariff would be levied as a special 17-day excursion fare. It would be applied during April and May, starting next year, as well as between October and March inclusive. These months are considered the off-season period on the North Atlantic run.

The proposed excursion fare compares with present all-year economy fare between New York and London of $462.

TWA's proposal, it was learned, is not meant as a threat of unilateral action on North Atlantic fares. The carrier feels that for its proposal to become effective it must be approved by all North Atlantic carriers and their respective governments. TWA's idea also would not settle the problem of what North Atlantic fares should be during the heavy tourist season.

OPENING SESSION of the 15th annual general meeting of IATA was held in the Peacock Room of the Imperial Hotel in Tokyo with Seijiro Yanagita, president of Japan Air Lines, presiding at lectern. Executive committee of IATA is seated at table.

IATA Girds for Supersonic Airliner Era

By Robert Hotz

Tokyo—The supersonic airliner moved another step closer to reality here last week as delegates to the 15th annual general meeting of the International Air Transport Assn. directed its techcal committee to organize a joint symposium with aircraft manufacturers aimed at laying the technical foundations for eventual introduction of this type equipment into airline service.

The technical committee, headed by Sanford B. Kauffman of Pan American World Airways, plans to hold the supersonic transport symposium in mid-1960 and envisions it as the beginning of the same type effort begun 10 years ago on the introduction of jet equipment into airline operations.

Technical Approach

The vote to begin the technical approach to supersonic transport problems reflected the general feeling among IATA delegates here that the question of flying their passengers faster than the speed of sound is no longer a question of "if" but simply "when."

Considerable off-the-floor discussion concerned the changes in international airline operations and economics that the advent of the supersonic transport, some 10 years hence, would require.

Retiring IATA President J. R. D. Tata, chairman of Air India International, reflected the changing airline attitude toward the inevitability of the supersonic jet transport in his remarks to the opening session.

"Our Jeremiahs have already looked upon the prospects of the 2,000 mph. civil transport as an unmitigated disaster," he told the delegates; "however, this ability to bridge great oceans in a few hours would bring such immense benefits to mankind in promoting trade, travel and communications that, in my view, nothing should be done to discourage or retard such a phenomenal step forward.

"Our prophets of doom seem to be under the impression that supersonic transports will totally replace subsonic planes as well as render them obsolete overnight and long before they are amortized.

"Actually the supersonic age is most unlikely upon us for another decade by which time our jet fleets will be reasonably depreciated on our books.

"Furthermore the supersonics, owing to their terrific speed and extreme operating altitudes, will be usefully employable only on long nonstop flights. People will presumably still want to travel over medium and short distances for which subsonic planes will continue to be required.

"As in other forms of transport the vast majority of travelers will want to travel as cheaply as possible. We have up to now tried to combine in a single vehicle the largely incompatible re-

New IATA President

Tokyo—Ake Rusck, president of Scandinavian Airlines System, was elected president of International Air Transport Assn. for 1960-61 succeeding Seijiro Yanagita, president of Japan Air Lines, who presided over the 15th annual general meeting here last week. SAS will be host to the 16th annual meeting next year Sept. 12-16 in Copenhagen. This IATA meeting will follow the annual flying display of the Society of British Aircraft Constructors at Farnborough, England, Sept. 5-11. IATA delegates at the Tokyo meeting also voted to hold their 1961 meeting in Sydney, Australia, where Qantas Empire Airways will be host.

The 1962 meeting of IATA is scheduled for Dublin with Aer Lingus as host. Vienna is being considered for the 1963 meeting.

quirements of luxury, speed and economy. The advent of supersonic jets may well force us into a new pattern in which separate types of aircraft best suited to each type of operation will be used.

"Whatever the ultimate pattern the sooner some sober and realistic thinking is done on the next step, particularly in the direction of satisfying the vast untapped demand for cheap air travel, the sooner will the air transport industry reach its full stature and fulfill its great mission."

Market Estimates

Rough estimates now indicate the market for the supersonic jet transport will be about 15% of the total jet fleet in the 1970s when most observers believe this type of equipment will begin airline service. One of the principal problems to be faced at IATA's initial technical symposium on the supersonic jet transport will be developing operational economy characteristics for this type vehicle suitable for airline standards.

Airline officials here were insistent that the supersonic designs must provide new standards of operating economy if they are to play the proper role in the future of international airline operations. Many feel that the supersonic jet will also intensify the trend already evident with subsonic jet transports of smaller operators pooling equipment purchases, operations and maintenance.

With the supersonic transport this trend may extend even to the larger airlines pooling operations and routes to keep these high speed transports whirling around the world at utilization rates sufficiently high to be economically profitable.

It is conceivable, some observers here believe, that a single supersonic jet transport might be operated by three or four different airlines in a single round-the-world schedule to compete with such well-established globe-girdling operators as Pan American World Airways and the French and British Commonwealth systems.

Technical Evaluations

In other technical actions, IATA has organized a program for European pilots to test-fly the experimental runway and approach lighting systems at the Federal Aviation Agency's Atlantic City research center. These operations will be conducted while pilots are on normal layovers in New York on transatlantic operations. IATA is also conducting a technical evaluation of British and U. S. blind landing systems aimed at developing a set of technically acceptable specifications for early operational use of this equipment. Similar evaluation is

V. SHANKAR (left), chairman of Indian Airways Corp., and his wife, and Herbert Salyer (right), Japan Air Lines tariff chief, and his wife, attend reception given IATA delegates by Wataru Narahasi, Japanese minister of transportation.

J. R. D. TATA (center in above photo), chairman of Air-India International and retiring IATA president, and his wife are greeted by Dr. Ryutaro Azuma, governor of Tokyo, at his reception for IATA delegates at Tokyo Kaikan. Reza Afsher, president and managing director of Iranian Airways, is shown below with Japanese dancers who performed ceremonial sword dances in the imperial palace.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

The Spoken Word

Air traffic control has been the subject of more aeronautical labor in the past 15 years than it is possible to tabulate. It has even created a new government agency—the Federal Aviation Agency. Yet a realistic look at where we stand today shows that:

- **We do not yet have an operationally** practical national program in being for the development of an air traffic control system for the future—and this statement is made with the full knowledge that FAA has awarded million-dollar contracts for this specific purpose.
- **We badly need machinery** to reduce required human control chores—especially communications data links.
- **For the foreseeable future** we will continue to depend on the human controller, hand labor, the microphone and individual judgment in the control of air traffic.

Key Facts

There are several key facts in the situation. Movement of aircraft today is dependent on the human voice via microphone and radio. We are doing little to improve these deplorable phonetic conditions, beyond our continual checker game of shifting communications frequencies. Many of our problems can be eased quite simply through the application of elementary semantics and certain principles of human behavior and other great strides can be made without complicated engineering studies or the outlay of vast sums of money.

How do we do these things? We re-examine the "approved" language for traffic clearances and airport landing directions. And please! In view of the horrendous job they did in revising the phonetic alphabet (AW July 28, 1952) "professors" should serve in a purely advisory capacity—if at all—while the practical operating people make these decisions. We also keep the lawyers out of the act (much, much easier said than done and quite possibly the stumbling block in my entire scheme) and guarantee chief controllers that the omission of a word during the exercise of reasonable controlling will not constitute "gross negligence." This thought can hardly be overstressed.

Much of our present day gobbledygook can be traced to the requirement that controllers read a complete legal document before an aeronautical operation is executed.

Reception Standards

Let us also examine the hi-fi standards of aeronautical communications. Is it too much to ask that aviation reception approach the fidelity obtainable at any record shop or super drug store? Airlines, for instance, should be advised that the purchase of lightweight, sensitive earphones will return dividends in less than a week when turbine aircraft save one minute each in the reception of traffic clearances. These airlines might also take a lesson from business aircraft and utilize the advantages of cockpit recording equipment.

And please, can't someone invent a warning light to indicate "frequency occupied" and so prevent transmissions being broken up when pilots transmit before determining that the channel is in use? In this day and age it is infinitely more glamorous to speak of sophisticated electronic intelligence systems than to mention plain English. Yet progress comes only through attention to the problems at hand. Our problem now is the spoken word. In succeeding columns we will try and spotlight additional exact truths.

being made on the doppler radar navigational computer in light of current and future ground navigational environments.

Another major area of current IATA technical work is development of jet operational procedures in Southeast Asia and South America where existing navigation and traffic control facilities are grossly inadequate.

Air traffic control problems which are being handled more efficiently at medium altitudes now are posing an even more acute problem with the mixture of military and civil jet traffic at high altitudes where the technical equipment for establishing positive control is still around the corner. Initial steps taken toward establishment of Euro-Control indicate that full coordination of military and civil air traffic in the western European area will be effective within another two years.

The technical committee also indicated that IATA hopes to make available a new method for determining real runway lengths required for jet aircraft at specific airports. This work follows circulation earlier this year of a modernized set of standards for jet airports.

Airline Traffic Figures Show Steady Increase

Washington—Scheduled airline traffic figures for this year are continuing to outstrip the 1958 growth pattern, according to the Civil Aeronautics Board.

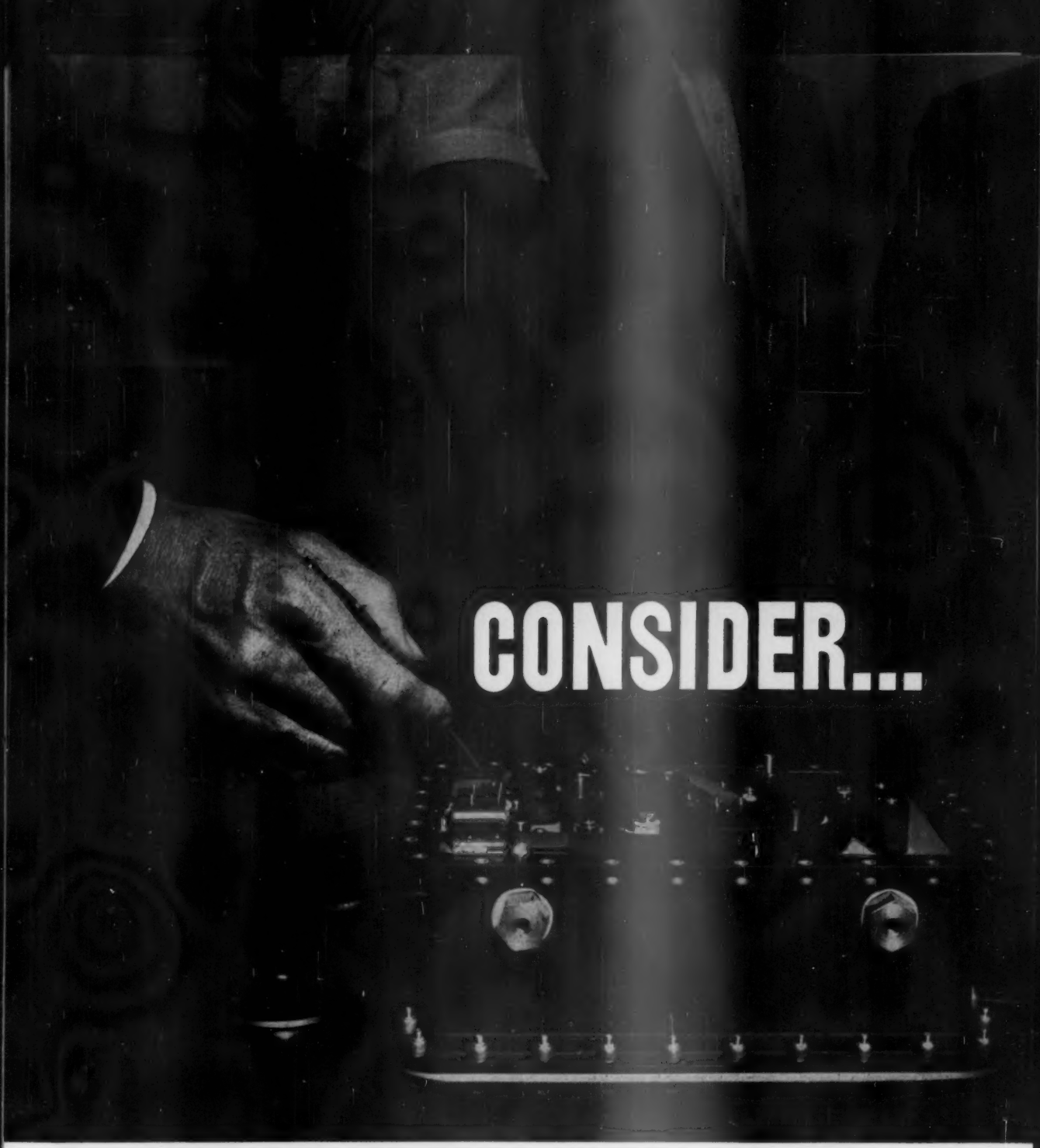
For the 12-month period ending in September, total domestic revenue passenger miles of 26.8 billion were up 9.1% over the total for the same 1958 period, with a domestic passenger load factor of 62.55%, a 3.74% gain.

Average domestic load factor for September was 63.56 as compared with 58.24 for September, 1958.

Available seat miles offered during the 12-month period ending in September totaled almost 43 billion as compared with 41.85 billion for the previous one-year period. Over the same period, revenue passenger miles of 11.57 billion were 15.6% above the 10 billion for the previous year period, and the 1.11 billion miles for September of this year are more than 30% above those during the same month of 1958.

Coach capacity also continued to climb, with available seat miles of 17.80 billion for the year ending in September representing a gain of 8.4% over the previous one-year period.

Load factor breakdown by the CAB showed a first-class domestic figure of 60.81% at the end of September as compared with 57.41% for the previous year. Domestic coach load factor for the year was 65.01% as compared with 60.99% for the previous year.



Lockheed's endless-loop tape recorders

DEVELOPED FOR SPACE COMMUNICATIONS, the recording capabilities of Lockheed's new endless-loop tape recorders are creating interest wherever the need exists for stored data in a critical environment. The original design is now operational in delayed and continuous recording and playback of stored data. Its endless-loop mechanism records and plays back in the same direction of tape travel... without rewind.

Variations of this lightweight, small size, low power consumption unit are available in a wide range of tape speeds and multiplicity of tracks. For more information on advanced recording techniques to meet your recording needs, write Marketing Branch, Lockheed Electronics and Avionics Division, 6201 East Randolph Street, Los Angeles 22, California.

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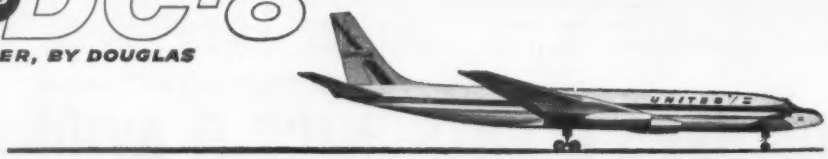

Braniff Electra Disintegrated In Flight, CAB Investigator Says

By Erwin J. Bulban

Buffalo, Tex.—Braniff Airways Lockheed Electra Flight 542 suffered in-flight disintegration prior to crash near here Sept. 29, Joseph Zamuda, chairman of the Civil Aeronautics Board team investigating causes of the accident, testified last week at the opening of the first phase of the Board hearings.

The left wing of the aircraft, which had separated between fuselage and No. 2 engine, hit the ground approximately 2¼ mi. from the main body of wreckage. The crash killed all 34 passengers and crew members. Initial testimony by eye witnesses pointed toward an in-flight explosion, followed by fire.

One witness, J. Cox, stated that prior to the crash he heard a noise which he estimated at between 150-175 db., saw a light-colored orange glow in the sky resembling burning phosphorous, which subsided, then renewed and went out completely. Soon after the light disappeared he saw a flash on the horizon at or near ground level. The initial glow was so bright that after it disappeared his vision was affected, he said, and he turned the lights of his convertible on and off several times before he realized they had been on at the start. Questioned about the noise, Cox stated that it was a shrill whine, very much resembling that of a ramjet. Cox, who has an engineering degree, was questioned as to his ability to discern noise levels. He stated that he once worked on a Navy ramjet project for Convair and was familiar with decibel ratings. Other witnesses also stated that they first saw a very bright flash in the sky which faded, then reappeared prior to the actual crash.

Flight 542 departed the Houston ramp at 2237, 22 min. behind schedule due to a discrepancy in No. 3 generator, which was inoperative on arrival at Houston. With the interchange of voltage regulators between No. 3 and No. 4 engines, the discrepancy was corrected and confirmed as operating properly in flight. The flight received its IFR clearance to the Leona omni via Victor Airway 13 west to the Gulf Coast, direct Leona, maintained 2,300 ft. to Gulf Coast, then climbed to and maintained 9,000 ft.

At approximately 2240 the flight was cleared for takeoff. Flight 542 acknowledged, then advised the tower it was holding clear of Runway 12 for a minute or so. At approximately 2242 the flight reported ready for takeoff and was airborne at 2244. Gross weight on departure was calculated to be 83,252 lb. with a total of 17,000 lb. of fuel. The authorized gross weight was 99,800 lb.

After takeoff from Houston, departure control advised Braniff 542 that it had the flight in radar contact, and requested the flight to report when established outbound on Houston 345 deg. radio. Flight 542 complied and was cleared to 9,000 ft. to contact San Antonio center on 120.1 mc. passing the Gulf Coast intersection.

At 2250 the recorded readings on the flight engineer's log recovered at the scene of the crash were as follows: Altitude 7,000, indicated airspeed 210, outside air temperature indicated plus 27, engine and airfoil anti-icing off, engine instrument indication normal.

At approximately 2252 Flight 542 reported to San Antonio center as being over Gulf Coast intersection at 9,000 ft. The flight was then issued its destination clearance to Love Field, Dallas, via direct Leona, direct to Trinidad, direct to Forney, direct to Dallas, to maintain 15,000 ft.

The flight was cleared to climb to its cruising altitude and at 2300 the flight engineer's log readings were as follows: altitude 15,000 ft., indicated airspeed 275, outside air temperature indicated plus 15 deg., engine and airfoil anti-icing off, engine instrument indication normal.

The next transmission from Flight 542 was to the San Antonio center, giving the time over Leona at 05 at 15,000. San Antonio acknowledged, and requested Flight 542 to change over and monitor Fort Worth frequency 120.8 at this time which the flight acknowledged.

Shortly thereatter, Flight 542 contacted company radio with a message for maintenance, advising that the generators were then okay, but because of insufficient time, maintenance was unable to insulate a terminal strip in the circuitry in the No. 3 propeller solenoid valve and the flight would like to have it done in Dallas.

This was followed by one other item for maintenance, the No. 3 sump pump out. This was the final transmission from the flight and was logged as being completed at 2307.

The in-flight disintegration occurred at approximately 2309, on course. Investigation disclosed that there were no emergency transmissions at any time during this flight.

Braniff 707 May Have Attempted Low-Speed Exercise Before Crash

Seattle—Braniff International Airways Boeing 707-220 turbojet transport which crashed here last week killing four crew members may have been performing the same type of low speed maneuvers which caused a Pan American jet to lose an engine pod near Paris earlier this year.

Although four crewmen survived the crash, they were in shock. They had been in the aft cabin when the airplane went into violent maneuvers. Civil Aeronautics Board personnel arrived in Seattle in the middle of last week to investigate the accident.

At the controls was Braniff pilot John A. Berke. First reports indicated he may have been flying with asymmetric power at minimum control speed with flaps down to either 30 or 40 deg. The aircraft was at 12,000 ft. when the trouble occurred.

According to reports, the airplane first apparently did a half snap roll to the right or left, followed immediately by a snap back into normal flight attitude. However, during the maneuver, the plane had lost three of its four Pratt & Whitney Aircraft JT4 (J75) engine pods, the one remaining being an inboard powerplant.

Russell H. Baum, Boeing experimental test pilot, apparently took over the controls immediately after violent gyrations and headed down for an emergency landing.

Baum used the one remaining engine, which reportedly was able to supply reasonable power level, to control the glide. However, with three engines gone the airplane had lost electrical and hydraulic power, could not raise the flaps and hence had to land with this drag situation. Landing gear was up.

The aircraft struck the ground on a small mid-river island. The plane broke in half just aft the wing, the front section traveling about 200 yd. farther on, landing on a bank of the river, and burned completely. Tail section remained on the small island, turned 90 deg. so the vertical tail was parallel with the ground.

The four crewmen who were in the aft cabin walked out of the broken section, then swam to shore and went for help.

The flight recorders installed in the aircraft had not yet been found late last week. They were being sought for clues as to the actual maneuvers the plane went through before the crash.

Experience Breeds 707 Training Changes

By Glenn Garrison

New York—American Airlines, nearing the home stretch in its Boeing 707-120 transition program, has constantly modified its jet training techniques as more is learned about the airplane.

The airline recently graduated its 110th captain from jet training, expects the total to reach about 130 early next year when the bulk of the 707-120 program will be completed. Another 130 copilots and about 140 flight engineers will have gone through the flight training program by that time.

Starting Problems

A pilot's strike just before service was scheduled to start last January, the usual weather problems in the New York area, unavailability of enough equipment as schedules were increased, and the loss of a plane in a training accident (AW Oct. 12, p. 45) added to the difficulties of running the jet transition program. Nevertheless it has provided crews for the 23 jets now in service to eight points on American's route system, and the airline will be ready for the next round of transition—to its Boeing 720s, scheduled to begin arriving in mid-1960.

Captains now are checking out in the 707-120 in an average of about 21 hr., according to William A. Reedholm, superintendent of flying and head of the 707-120 training program. This average fluctuates between 17 hr. and 22 hr.

American has refined its training techniques by adding to, and modifying, exercises recommended by the manufacturer and further developing its own exercises.

For example, the airline decided to add a sink rate exercise. Since the airplane is flown so much where sink rate-airspeed combination is important, American thought its pilots should practice it, but it was not specifically recommended by Boeing, Reedholm said.

Rudder Exercise

On the other hand, training in flight at minimum rudder control speed has been eliminated. Students now go through an exercise to demonstrate rudder effectiveness, but they don't do it at minimum control speed of about 125-130 kt. (depending on load and other factors). According to Reedholm, the exercise at minimum speed resulted in several airline training incidents, including the Pan American loss of an engine pod over France.

Pilots beginning training in the jet often show apprehension, Reedholm said, but by the time they check out they have grown enthusiastic about it. It calls for modifying some deeply ingrained habits of the veteran airline pilot.

Two typical recent graduates of the jet transition program, Los Angeles-based former Douglas DC-7 Captains W. T. Fletcher and Earl Phillips, now are Federal Aviation Agency-rated in the jet and are back at home base for line qualification training. To illustrate details of the flight training, here is an account of their work during a late phase of their program:

Fletcher and Phillips were scheduled to take off on a recent Friday afternoon, primarily for some landings and approach work. At that point Fletcher had logged 12 hr. 40 min. of seat time in the 707, plus 20 hr. 18 min. of observer time in flight and 16 hr. of simulator time. Phillips had 12 hr. 10 min. of seat time, 19 hr. 48 min. of observer time and 17 hr. in the simulator (minimum simulator time is 16 hr., with the average around 20 hr.). Their instructor was Harold Grewe, a 20-year American veteran with about 325 hr. of 707 time.

Crew Members

Other crew members were Ray Jacobson, flight engineer instructor, and A. B. Coffran, flight engineer student, with 6 hr. 31 min. of time in the jet plus 3 hr. 10 min. as observer. An Aviation Week editor rode in a jump seat on the flight deck.

Grumman's airport at Peconic, N. Y., is the preferred site for American's training work, but the weather was 800 ft. ceiling, overcast and rain at Peconic. Baltimore, the second choice, also reported unfavorable weather. The flight therefore was planned to Detroit, where a dual 10,500-ft. runway is usually available for the jet work.

The airplane had flown a scheduled Dallas-New York trip the day before, actually going into Newark because of Idlewild weather. It was ferried over for the training flight and took off at 2:10 p.m. at 212,000 lb. gross weight including 90,000 lb. of fuel. Takeoff was from anti-noise Runway 25 against a 15 kt. west-southwest wind.

Phillips made the takeoff from the left seat and took the airplane via airways to Detroit, cruising at 22,000 ft. This phase of the flight, other than providing navigation and normal operating experience for Phillips, was waste motion as far as special training maneuvers were concerned. Little air work could be done while cruising airways.

In a little over an hour, however, Phillips was able to begin his first simulated ILS approach into Detroit. He made two, breaking each off at about 200 ft. and incidentally burning off fuel to get down to the maximum landing weight of 175,000 lb.

During the procedure turn for the second approach, Grewe pulled the circuit breaker which deactivated the captain's compass, but Phillips noticed the warning flag and "bootstrapped" it, or switched to a repeater arrangement from the other compass.

Bounce on Touchdown

Phillips went around for a third approach and came in for a landing, touching down with a long bounce. This landing was followed by a takeoff during which Grewe pulled back the throttle. Minimum engine cut speed for training is 125 kt., or in excess of V_1, and the V_2 in this case was 136 kt. Phillips rotated the nose at the instructor's command, lifted the plane off and reached about 1,300 ft. before starting his engine-out check list.

As Grewe pointed out, there is more time in a jet than a piston aircraft to get the climb established before attending to the check list. Loss of a piston engine may involve a runaway propeller, in which case it would be vital to identify the engine and shut it down at once. With the jet, there is little change in drag with an engine out and the only possible need for immediate identification is in the case of an engine fire.

The gear was not retracted after takeoff and No. 1 engine was put back into operation for the go-around. Leaving the gear down prevents excessive brake heating in repeated landings at short intervals and putting power back on the engine with simulated failure prevents the other three from developing high oil temperatures. Turning into the approach, the engine was cut back again to continue the simulated one-engine-out go-around and landing.

The airplane was on the ground again at 4:10 p.m. and the landing could not be described as gentle. Phillips practiced four more, with various single inboard or outboard engines cut on takeoff except in one case. That time, Grewe moved his left hand as though cutting No. 1 but did not actually touch the throttle. Phillips tensed for the correction that wasn't necessary. "I was spring-loaded for an engine out that didn't happen," he admitted to Grewe.

The instructor advised Phillips that he was unconsciously rotating the nose a little as he crossed the fence, which is too soon, and that was why his landings were a trifle off. It was a matter of a small difference in timing.

Fletcher took over at 4:55 p. m. and got in two takeoffs and landings before the training flight was cut short by loss of the plane to a scheduled trip. A Boston-Los Angeles 707 revenue flight had landed a few minutes earlier and an engine change was found to be necessary. During runway repairs at Boston, normally nonstop Trip 11 had been stopping for fuel anyway, but in this case No. 1 engine had ingested a seagull on takeoff from Boston.

The training crew took the opportunity to examine the engine, which showed stator blade damage. Trip 11's captain pulled a swatch of feathers from his uniform pocket, all that was left of the gull, and reported that the engine had not been shut down during the flight and had performed normally.

"But it sounded like a thrashing machine when we drove up to the ramp," he added.

The training landings at Detroit had been made under two handicaps which probably affected the students' timing: a 15-20 mph. quartering right crosswind and the fact that the pattern involved right turns instead of left turns as they had been making at Peconic.

The training crew boarded a scheduled Electra for the trip back to New York. With a 707 available the next morning, the student pilots and student flight engineer then went to their rooms in the International Hotel, located on the airport near American's hangar.

Despite the disadvantages of New York for the jet training—disadvantages which include a good portion of bad weather—Reedholm thinks it is the best available compromise. Using the Peconic airport takes the training flights away from traffic problems. There are two excellent long runways there and navigation facilities—radio range, ILS, omni are new and complete. Maintenance of the runways and taxiways is good and they are kept clean of debris.

American has not yet decided where transition flight training for the smaller Boeing and the Convair 600 will be held. Besides Idlewild, a possibility is Tulsa, Okla., where the airline's big maintenance base is located.

Training now is scheduled at 15 hr. a day of flying and this will be the pace until the 707-120 program is finished. At its peak, flight hours reached 30 a day—six sessions of five hours each. Present schedule calls for two "dawn patrols" and an afternoon flight. One of the morning flights, however, is made with a layover airplane from scheduled service and this ship is sometimes not available for training. The whole problem of making airplanes available for the large-scale training program is a delicate one. As Reedholm points out, one can't fly schedules if the pilots haven't been trained, but on the other hand one would rather not antagonize a planeload of customers when a jet is needed for a schedule.

The student captains rolled out early to continue their interrupted training exercise, with takeoff scheduled for 7:30 a.m. They found, however, that there would be a two-hour delay while a no-go modification was made to the airplane.

Company order for this modification had come through the night before. Made on a fleet-wide basis by American and other operators of the 707, it involved removal of a rudder feel spring to decrease rudder force in certain engine-out flight conditions (AW Oct. 12, p. 45). A Boeing bulletin also advised pilots regarding control characteristics of the airplane, as follows:

"Rudder characteristics of the airplane are such that when sideslip yaw angles in excess of approximately 10 deg. are attained, rudder effectiveness deteriorates quite rapidly with a resultant loss of directional control. In order to minimize the probability of obtaining large sideslip-yaw angles with one outboard or both engines on one side inoperative, maintain directional control with rudder and maintain this amount of rudder if turns are made. Do not use excessive aileron or bank angles to maintain directional control. Sideslip angle yaw angles of approximately 10 deg. result in nearly full aileron control to maintain heading when inadequate rudder is applied. This provides means for pilot recognition of inadequate rudder application; therefore if during engine-out operation, more than 30 deg. of control wheel rotation toward the operating engines are required to maintain straight flight or steady turning flight, then one or more of the following corrective actions should be taken immediately:

"1) Apply additional rudder if available, toward the operation of the engines.

"2) Increase airspeed.

"3) Decrease thrust on operating engines side.

"Note: There is a noticeable stiffening of rudder pedal forces during the last 2 or 3 deg. of rudder deflection; therefore if any maneuver requires full rudder deflection, the pilot should be certain to depress the rudder pedal fully."

Reedholm took over as instructor for the Saturday morning flight, under a system that alternates two instructors with every pair of transition students. The students usually are scheduled for

Two 707-320s Near Service Dates

First Boeing 707-320 Intercontinental ordered by Trans World Airlines makes maiden flight, above. TWA plans to begin service with the Intercontinental between New York and London on Nov. 23. The first of five 707-320 Intercontinentals ordered by Sabena Belgian World Airways is rolled out, below. This aircraft is expected to make its first flight early next month and will be delivered to Sabena in early December. The airplane will begin nonstop service between Brussels and New York on Feb. 15.

four days of training with two days off.

Use of the two alternating pilot instructors is another example of the evolution of techniques in the training program. Originally a single instructor stayed with the students, then several instructors were alternated, and finally the two-instructor system was selected as best. There are normally eight instructors in the over-all program.

In about a half hour of preflight briefing, Reedholm told his student pilots, among other things, that they were going to get some exercises in which a jammed stabilizer would be simulated in addition to a runaway stabilizer, thus "compounding" the condition. This would rarely happen in actual operation, Reedholm said. He told them to be alert for runaway trim tab at all times. The need always to keep aircraft trimmed is stressed during training program, and sometimes the instructor will intentionally leave the plane with insufficient trim and ask the student to do an approach to the prestall buffet. The pilot will then wind up with yoke all the way back and a high sink rate, unable to bring up the nose. This exercise impresses on the pilot that if he came in for an actual landing with improper trim he might not be able to break the sink rate at the proper point.

No-flap approaches also were on the agenda, Reedholm said. He advised the students to remember their sink rate exercises. Make the no-flap approaches with a slightly longer final to provide more time, he said, and keep sink rate well below a maximum of 1,200 ft./min. Desired sink rate is 500-700 ft.

Discussing landing sequence, Fletcher said it seemed to him a lot of runway was being "given away" in his landings, and wondered if his brake pressure was too light.

Actually Fletcher has found use of the brakes to be one of the habits he has had to unlearn from his piston-engine experience. The anti-skid brakes of the jet allow a far rougher technique. Reedholm said they were going to do minimum stopping distance exercises in the next session and, "You'll be surprised how quick you can stop."

The delayed training flight finally was airborne at 10:26 a. m., taking off from Runway 7 in excellent weather against a 10-kt. northeast wind. Gross was 201,750 lb. with 80,000 lb. of fuel and 4,000 lb. of water. Fletcher headed the airplane east along the south Long Island coast and went to 15,000 ft. to fly an emergency descent exercise. Procedure is to cut throttles, apply full spoiler, bank 30 deg. left or right, and drop gear when airspeed is down to 270 kt. With the gear out and the gear door closed again, the airspeed can be brought back up. American's maximum airspeed at this point is 300 kt. in the training exercise, held that low because roll rate is high with the spoilers out. The 30 deg. bank angle represents a reduction from 45 deg. in Boeing's recommendation, according to Reedholm—another example of the modification of techniques the airline has made.

The simulated emergency descent was broken off at 10,000 ft. Next Fletcher did 45 deg. turns with 250 kt. airspeed. This is the more difficult of two such exercises, the other involving an airspeed of 300 kt. Reedholm then called for stall exercises, and Fletcher took the airplane into the prestall buffet. Configuration is hands-off trim at 500 fpm. climb and 140% of stall speed, in this case about 175 kt. Power is cut back and burble begins around 140 kt. Because the exercise involves going only a little way into the prestall buffet, the feel, at least from the jump seat, seemed slight. Reedholm, to demonstrate further, took the controls and went deeper into the buffet, which could definitely be felt. Reedholm recovered and went deliberately into a pre-secondary-stall buffet, losing not more than 300 ft. of altitude in the whole process.

Canyon Approaches

Fletcher now set up for some canyon approaches: gear down, 40 deg, flap, bring speed down to reference plus 10 kt., descend 2,000 ft. (to 8,000 in this case), level and hold for 30 sec. at reference plus 10 kt., initiate climbing turn to right or left, flaps to 30 deg. and increase reference speed to plus 20 kt., and finish on reversed course. Reedholm believes canyon approach exercises are valuable, although some other airlines have discontinued them with jets as unprofitable. For one thing, Reedholm says, the maneuver closely simulates a pull-out and right turn away from an Idlewild runway.

To add to Fletcher's burdens, Reedholm chopped single engines while the student was in his climbing turns in the canyon exercise. To maintain his airspeed, Fletcher reduced rate of climb from 1,000-2,000 to 300-500 fpm.

With Phillips in the captain's seat, the maneuvers were repeated and a directional control exercise was done with both engines out on the right side. American's minimum altitude for this exercise or any asymmetrical two-engine work was set at 3,500 ft. after the training accident, and Federal Aviation Agency, also after the accident, required that such training be done "at altitude."

Phillips made a simulated ILS at MacArthur Airport and one at Peconic and turned his seat over to Fletcher again for an ILS at Peconic. Reedholm took the power off No. 4 for this approach, which was broken off about 90 ft. over the runway. The instructor reminded Fletcher to remember the possibility of yaw with the engine-out condition and to be ready for it when applying power to the three working engines. Reedholm advised him to bring in some left rudder while the power was still being applied.

On the second approach, this time for a landing, No. 1 engine was cut. Reedholm told Fletcher he was turning the wheel but not doing anything to the airplane. That is, Fletcher was overcontrolling and moving the wheel so rapidly that the plane had no chance to respond. Fletcher touched down in a smooth landing.

After the takeoff with No. 3 engine cut back, Fletcher went around for a no-flap approach. Reference speed was 135 kt. and the approach was made at this speed plus 20%. Fletcher got into a slight Dutch roll condition on the approach and corrected it.

Jammed stabilizer approaches, with landings, were Fletcher's next assignment. Nose was pitched down, and the student was required to deactivate the inboard spoilers and control the pitch by using the speed brakes.

Another exercise was a higher than normal approach, using spoilers to kill off excess altitude. Earlier in the training program, the jet was brought in fairly close to the landing with the speed brake, but the maneuver is now completed well out from runway. Reedholm said this provides enough of an exercise in using the speed brake and it is not necessary to demonstrate the maximum capability.

Fletcher next made an approach and landing with both outboard engines cut back. Speed in the approach is reference plus 20 kt. or 150 kt., whichever is greater. Reference in this case was 130 kt. Sink rate was kept between 500 and 700 fpm. in the final stages, airspeed was 160-180 kt. in final and 145 kt. over the fence.

Phillips took over for jammed stabilizer, high approach and two-engine-out exercises. On one takeoff, No. 3 engine was cut at 125 kt. Reedholm waited until speed was 160 kt. before he directed Phillips to rotate the nose. Weight of the airplane at this point was about 131,000 lb. Purpose of holding the plane on the runway well past V_2 was to provide practice in maintaining directional control on the runway with the engine-out condition.

The day's work was over at 3:57 p.m. when the plane touched down at Idlewild. Reedholm later reported that the pilots had put in 2½ hr. each of further training and then passed their FAA rating check in a flight of 5 hr. 25 min. split between them. Neither was required to repeat any exercise.

SHORTLINES

► **Continental Airlines** reports that it flew 71 million revenue passenger miles during September, a 92% increase over the same month in 1958. The airline now operates six daily round trip Boeing 707 flights between Chicago and Los Angeles. Continental's combined air mail, freight and express traffic rose 58% over September, 1958, to 509,282 ton-miles. Continental will introduce night coach fares on its turbojet service between Kansas City and Los Angeles on Nov. 15. Passengers flying in the 48-seat first-class compartment of the 707 will pay the present $78.75 coach fare; those riding in the 62-seat coach compartment will pay $65.50, a 17% reduction from the coach fare.

► **Eastern Air Lines** will begin operations at its new passenger terminal at New York International Airport on Oct. 29. Construction on the new terminal was begun in September, 1957. Eastern has taken delivery on the last of its order of 40 Lockheed Electra turboprop transports. Since the airline introduced the aircraft on its routes on Jan. 12, more than 810,000 passengers have been flown 637,225,265 passenger miles.

► **Flying Tiger Line** reports a 29.1% increase in airfreight revenues last month over September, 1958, for a total of $1,454,203. Airfreight revenues for the first nine months of 1959 have increased by 33.9% to $11,278,328.

► **Northwest Airlines** carried 166,332 domestic passengers in September, an 18.3% increase over the same month of last year, and flew 127,502,410 domestic revenue passenger miles, for an increase of 22.6%. International revenue passenger miles were up 21.7% at 33,099,327 for a total system-wide revenue passenger miles figure of 160,601,737, up 22.4% from September, 1958.

► **Pan American World Airways** will begin serving Caribbean resort areas from New York and Miami with Boeing 707 aircraft on Dec. 10. Initial schedules call for the following: San Juan from both New York and Miami, daily service; New York to Nassau, six weekly flights; New York to Ciudad Trujillo, four flights weekly; Miami to Montego Bay, Jamaica, and Ciudad Trujillo, four flights per week. In addition to its Caribbean services, Pan American plans to begin six weekly 707 flights from New York to Caracas on Nov. 1 and increase its present twice-weekly 707 flights to Caracas, Asuncion and Buenos Aires to four a week.

AIRLINE OBSERVER

(The following column was compiled by Aviation Week staff members covering the 15th annual general meeting of the International Air Transport Assn. in Tokyo:)

► First break in the Bamboo Curtain of Communist China may come from current negotiations between the Minhaiduy Civil Aviation Administration of China and Air Ceylon for reciprocal traffic rights over the Canton-Colombo route.

► **Perennial friction between aircraft and engine manufacturers and the IATA staff erupted again at the Tokyo annual general meeting with a last-minute decision by the IATA staff to omit all manufacturers from the general meeting social functions. Canadian, United States, British and French manufacturers combined to host an evening's entertainment aboard a ship in Tokyo harbor after the sessions formally closed. Both airline officials and manufacturers feel that whatever the problems are concerning manufacturers' participation in IATA non-business functions they should be worked out with a permanent set of mutually agreed-upon ground rules replacing the annual acrimonious tussles on this issue.**

► Indian Airlines Corp. has begun its Douglas DC-3 replacement program with an order for five Fokker F-27 twin Dart turboprop transports plus an option for five more. IAC also plans to add four more planes to its current Viscount fleet, buying three 800 series from Union of Burma Airways Board which recently suspended its international operations and another directly from Vickers-Armstrongs.

► **Air-India International will implement its transatlantic route in the spring of 1961. The airline wants operational experience with its Boeing 707-437 transports which it will introduce early next year on its London-India route before it undertakes the long-haul Bombay-New York service.**

► Allison Division of General Motors Corp. is looking for an Asiatic manufacturer to build its 6,500 eshp. T-61 turboprop for both military and civil transport and handle regional overhaul work. Allison feels there is a rapidly growing market for turboprop transports in Asia.

► **Garuda Indonesian Airways' long-standing order for three Lockheed Electras is still being held up because of lack of financing.**

► First attempts to form a United Arab Republic airline failed to produce any major agreements among the Arab countries involved.

► **Sharp U. S.-British competition may develop in India over local manufacturers of a twin turboprop transport for both civil and military use. Indian government has authorized construction of the Avro 748 transport in India for local air force transport requirements but Indian civil aviation circles are also interested in a Lockheed Aircraft Corp. design for a twin-engine turboprop transport to be built in India aimed at the airline market for Douglas DC-3 replacements in Asia. The Lockheed design would be powered by two Rolls-Royce Dart turboprops.**

► Convair Division of General Dynamics Corp. has made a survey of how many of its Convairliner 330 and 440 models now in airline service will be available for resale during the next five years. Results indicate few will be available before 1962. Convair is planning a program to buy any of these models that become available, overhaul and modernize them at its San Diego plant and then resell them to airlines.

► **Japan's entry in the DC-3 replacement market, the twin-turboprop YS-11 transport (AW Aug. 4, 1958, p. 43) now being built by the Nihon Aeroplane Manufacturing Co. headed by Paul T. Shoda, is scheduled to fly in prototype form early in 1961. It will be powered by two Rolls-Royce R.Da.10 turboprops with a civil rating of 2,600 eshp.**

HIGHEST JET AGE PROFIT

A MONEY-MAKER FROM THE START!

The new jet-prop Vanguard, now undergoing meticulous flight testing, will offer American carriers a comfortable profit picture right from the date of its introduction to service—and at coach fares.

But Vanguard has the large, well-balanced payload capacity to absorb expanding traffic—and as it does, the profit picture gets even better. Assuming modest annual traffic increases of 8% for passengers (the current rate is 11% and is expected to rise) and 13% for freight, a net profit of *$11½ million* can easily be earned by a single Vanguard in seven years on a 300-mile sector.

300-MILE SECTOR TRIP PROFIT—A CONSERVATIVE FORECAST

YEAR	PASSENGERS	MAIL & EXPRESS	FREIGHT	TRIP PROFIT
1968	103	500 MAIL LB. 250 EXPRESS LB.	4,165 LB.	$685
1966	88	500 MAIL LB. 250 EXPRESS LB.	3,265 LB.	$434
1964	76	500 MAIL LB. 250 EXPRESS LB.	2,555 LB.	$226
1962	65	500 MAIL LB. 250 EXPRESS LB.	2,000 LB.	$ 39

***NEWEST* FROM THE WORLD LEADER IN JET-PROP AIRCRAFT . . .**

POWERED BY FOUR ROLLS-ROYCE TYNE ENGINES

POTENTIAL

139 passengers . . . 8 tons of freight . . . 425 mph . . . 2300-mile range

PROMOTIONAL FARES CAN BE PROFITABLE!

With seat-mile direct costs of 1.4 cents at 200 miles and 1 cent at 1,000 miles, Vanguard opens the door to promotional fares and other traffic-stimulating plans. And, by raising load factors faster through these plans, Vanguard profitability becomes considerably more attractive than indicated above. As an example, on a 350-mile sector, passenger break-even would be only about 43% plus 3 tons of freight—*with coach fares reduced 25%!*

ALL THIS PLUS PASSENGER APPEAL!

Passengers are certain to take to Vanguard. Cabin quiet and comfort compare favorably with the Viscount. Speed has been proved competitive with jets and is even better on the shorter sectors because of jet-prop flexibility. And, because Vanguard presents no problems in meeting ATC problems, delays in high-traffic areas will be minimized.

For further details and a cost analysis based on your operations, contact Christopher Clarkson, U.S. representative, 10 Rockefeller Plaza, New York 20, N.Y.

WORLD'S ONLY 2nd GENERATION JET AGE AIRLINER!
Vanguard benefits greatly from the more than 2 million hours of worldwide in-the-air experience of 400 Viscounts . . . and there is *no* substitute for experience!

VICKERS

VANGUARD

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. · WEYBRIDGE, ENGLAND · MEMBER COMPANY OF THE VICKERS GROUP

Airline Income & Expenses—August, 1959

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	32,124,472	594,778	360,632	1,884,576	.....	35,375,023	30,798,236	4,576,787
Braniff	4,896,832	135,103	65,588	200,967	40,147	5,418,408	5,147,311	203,863
Capital	8,607,212	176,434	116,264	133,845	32,861	9,215,143	9,114,434	100,709[2]
Continental	4,794,000	54,000	32,000	70,000	30,000	5,061,000	4,179,000	591,000
Delta	7,623,000	164,000	103,000	345,000	.....	8,414,000	7,934,000	493,000
Eastern	21,830,169	374,235	869,637[2]	.....	68,238	23,270,127	23,043,304	−115,163
National	4,184,021	79,821	30,294	141,472	96,601	4,577,493	5,049,184	−401,591
Northeast	2,831,585	33,697	19,388	48,012	.....	2,981,046	3,169,487	188,441[3]
Northwest	7,493,183	181,300	536,510[2]	.....	8,452	8,294,305	6,652,765	2,195,232
Trans World	25,324,861	450,768	1,116,464[2]	.....	138,161	27,138,092	21,933,552	5,624,116
United	25,823,885	792,761	2,157,225[2]	.....	362,637	29,570,617	24,745,811	5,070,887
Western	5,759,690	97,531	41,000	66,176	21,297	6,067,759	4,318,376	1,685,624
INTERNATIONAL								
American	573,591	9,258	355	40,032	.....	650,855	572,433	78,422
Braniff	680,556	12,304	.....	38,866	.....	777,049	698,904	69,134
Caribbean Atlantic	264,186	2,304	10,383[2]	.....	2,269	282,269	218,710	63,399
Delta	487,000	4,000	.....	7,000	.....	519,000	472,000	46,000
Eastern	2,535,818	4,537	97,867[2]	.....	39,130	2,699,056	2,181,020	478,859
Mackey	174,775	.....	302	2,962	.....	184,823	154,364	30,459[3]
National	333,249	4,286	3,254	10,175	.....	359,812	354,036	5,776
Northwest	2,849,664	528,676	422,216[2]	.....	3,816	3,901,905	3,099,986	858,147
Pan American Combined	28,759,000	1,412,000	.....	3,278,000	979,000	35,515,000	30,434,000	4,841,000
Alaska	460,000	15,000	.....	45,000	.....	537,000	514,000	24,000
Atlantic	14,155,000	646,000	.....	1,088,000	166,000	16,530,000	13,172,000	3,317,000
Latin America	7,795,000	191,000	.....	1,271,000	166,000	9,753,000	8,986,000	769,000
Pacific	6,349,000	560,000	.....	874,000	647,000	8,695,000	7,754,000	953,000
Panagra	1,268,000	45,000	.....	170,000	40,000	1,665,000	1,653,000	23,000
Resort	12,877	.....	.....	.....	213,755[4]	239,788	267,623	−27,835[3]
Trans Caribbean	412,259	.....	52,631[2]	.....	17,039	535,029	452,755	75,540
Trans World	6,375,229	439,773	334,029[2]	.....	1,330,194	8,713,339	8,215,112	473,103
United	2,097,917	50,827	28,401[2]	.....	.....	2,189,953	1,405,954	776,261
Western	413,198	8,009	.....	3,059	.....	431,848	342,546	83,770
LOCAL SERVICE								
Allegheny	780,955	10,650	11,572	22,391	2,478[4]	1,040,483	1,067,667	−27,184[3]
Bonanza	318,690	2,855	1,534	5,367	17,511	503,127	536,355	−45,635
Central	194,735	7,000	2,018	7,752	7,625	458,205	448,905	9,300[3]
Frontier	587,799	12,702	3,672	32,342	12,855	1,040,636	1,192,444	−167,384
Lake Central	234,668	8,771	9,222[2]	.....	.....	405,406	384,480	20,926[2]
Mohawk	696,797	7,328	7,682	11,420	17,362	918,722	880,681	38,401[2]
North Central	1,179,468	25,985	21,500	17,400	28,708[4]	1,664,466	1,624,647	19,901
Ozark	622,389	298,349[6]	10,872	22,308	.....	962,268	891,670	65,386
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont[7]	694,194	10,659	6,517	10,700	19,104[4]	1,036,447	1,007,554	9,995
Southern	217,375	8,221	4,231	8,327	3,229	445,658	474,043	−28,385[3]
Trans-Texas	422,560	11,441	4,388	17,193	12,760	726,970	700,248	23,917
West Coast	476,339	4,696	2,838	8,268	3,465	642,456	773,345	−130,890[3]
HAWAIIAN								
Aloha	474,479	2,080	.....	5,445	.....	494,466	384,363	110,103[3]
Hawaiian	694,853	2,213	.....	68,965	73,241[4]	857,475	770,599	64,209
CARGO LINES								
AAXICO[1]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	103,595[5]	.....	.....	.....	82,256[9]	185,851	187,477	−1,626[2]
Flying Tiger	.....	10,207	1,260,869	.....	1,173,994	2,433,290	2,278,132	50,950
Riddle[1]	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	.....	.....	.....	.....	.....	1,608,911	1,867,542	−258,631[3]
Slick	.....	.....	.....	.....	999,741	1,058,737	953,637	105,100[3]
HELICOPTER LINES								
Chicago Helicopter[1]	.....	.....	.....	.....	.....	.....	.....	.....
Los Angeles[1]	.....	.....	.....	.....	.....	.....	.....	.....
New York Airways	98,243	3,966	1,485	3,794	.....	305,684	292,962	11,031
ALASKA LINES								
Alaska Airlines	304,703	57,936	1,457	56,864	216,750	761,720	745,220	3,594
Alaska Coastal[1]	.....	.....	.....	.....	.....	.....	.....	.....
Cordova	18,687	12,100	.....	8,833	45,274	113,460	103,884	18,092
Ellis	80,500	5,700	9,000[2]	.....	5,100	131,400	112,600	18,800[3]
Northern Consolidated	125,483	41,150	.....	39,722	23,945[4]	294,268	263,270	30,999[3]
Pacific Northern	1,035,588	67,413	2,702	88,870	1,056	1,350,920	1,084,736	252,721
Reeve Aleutian	146,279	33,240	.....	30,544[8]	24,085	246,670	182,742	60,325
Wien Alaska	216,389	50,056	.....	38,896	167,200	546,901	523,642	23,259[3]

[1] Not available. [2] Property figure. [3] Net operating income or loss. [4] Non-scheduled transportation. [5] Common carriage.
[6] Includes federal subsidy. [7] Airline division figures. [8] Freight & excess baggage. [9] Military air transport service contract.

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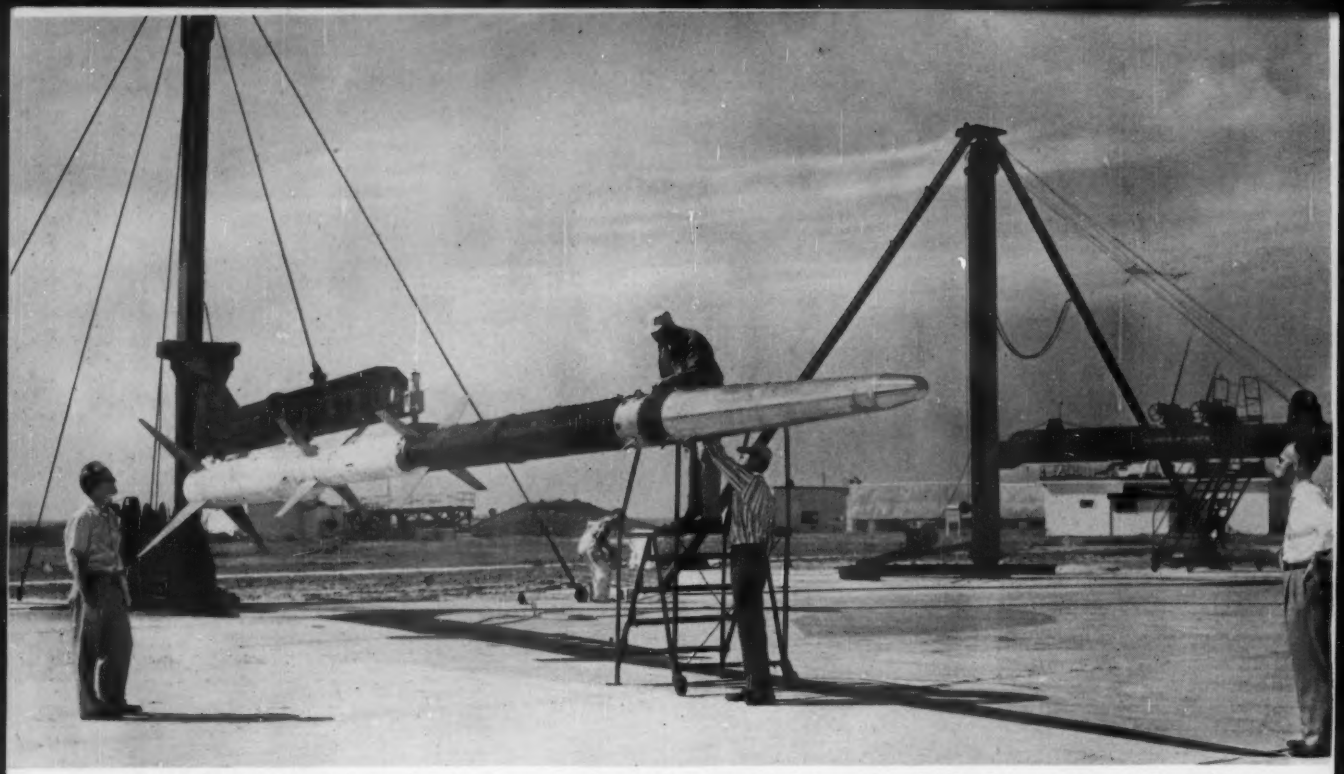


SIX STAGE ROCKET which fires last three stages on downward trajectory is being used by National Aeronautics and Space Administration to study effects of plasma sheath which surrounds bodies re-entering atmosphere on their detectability, ability to telemeter information, and effects of protective materials on these capabilities.

Down-Firing Rockets Probe Re-Entry

By Evert Clark

Langley Field, Va.—Unique method of making bodies re-enter the earth's atmosphere at velocities up to the meteoric speed range—24,000 to 160,000 mph.—has been developed by National Aeronautics and Space Administration.

The technique is now being used primarily to study the physics of re-entry in connection with ballistic missile warhead detection problems, but it can be extended to study re-entry of space ships from interplanetary flights at velocities well above missile re-entry speeds and for basic research on the interactions of the atmosphere with natural bodies such as meteors.

Six-Stage Rocket

The work is being directed by the Pilotless Aircraft Research Division of NASA's Langley Research Center here. It involves the use of an inexpensive six-stage solid-fueled rocket (AW Oct. 19, p. 26), five stages of which are modifications of standard military hardware. Rockets are fired over the Atlantic Ocean from NASA's Wallops Station, about 70 mi. from here.

The sixth stage is a spherical rocket motor, developed by NASA, that is expected to have many applications in space because of its high mass ratio. The NASA motor, only 5 in. in diameter, is the first ever to be flight tested. Several companies are manufacturing and have ground-tested much larger spherical engines.

Some of the spherical motor work is being done under contract to NASA.

Re-entry speeds are achieved without going to large, expensive ballistic missiles themselves simply by firing the last three stages of the rocket almost straight downward into the atmosphere.

These three stages, which NASA calls the "velocity package," are lifted to an altitude of about 200 mi. to approximately the edge of the exosphere by an Honest John booster, a Nike booster and the Lance rocket that has been used as a booster for the X-7 ramjet test vehicle.

These stages are fired in quick succession to gain maximum velocity and, therefore, maximum altitude. Drag separates the first stage. A blowout diaphragm is used in separating the second stage from the third. Third stage fins are canted slightly to give the vehicle enough spin to stabilize it, since the simple system carries no guidance and no stabilizing rockets. This stage coasts upward with the velocity package until it is well above the sensible atmosphere to maintain stability and give the vehicle extra inertia.

Launch Angle

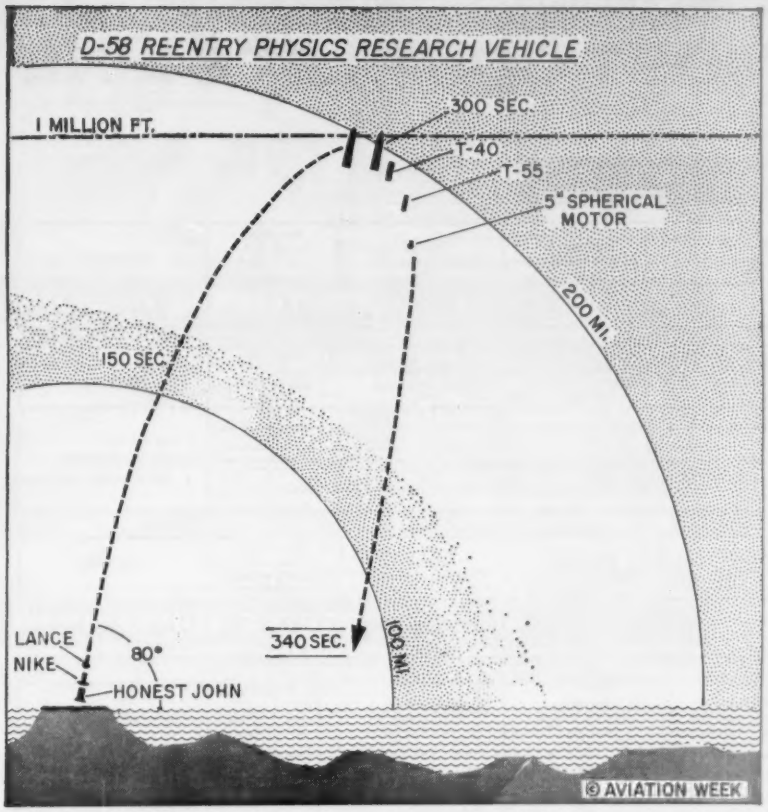
Since the velocity package will remain in the attitude it had at launch and will fire back downward at the same angle, the launching angle is critical. (In firings so far, the angle is 80 deg. from the horizontal.) Because of the final part of the package must re-enter within the range of the radar, optical and other detection systems being used in the current group of experiments, this angle must be high to keep lateral range short.

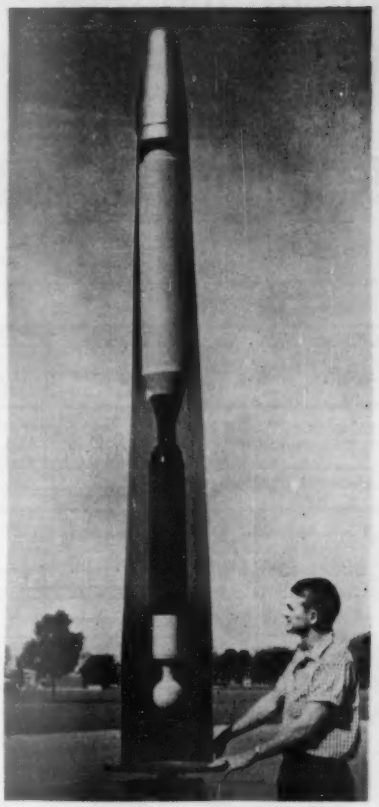
Safety favors a much lower launch

Detection in Space

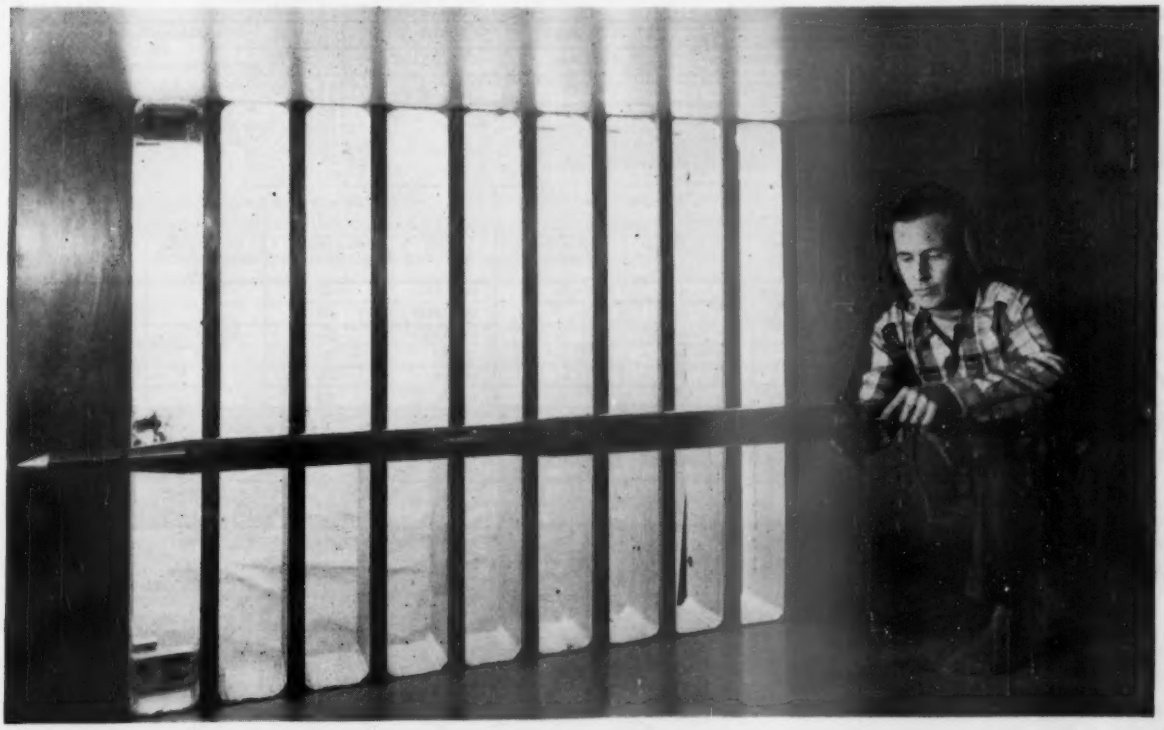
Detection of re-entering bodies by ground stations is only one phase of the anti-missile missile and anti-satellite detection problem being studied by National Aeronautics and Space Administration.

NASA has been exploring an experiment that would allow it to put both the detecting device and the object to be detected into space where there would be no deterioration of radio or optical signal propagation. Solution of the problems involved in this technique also would have application in rendezvousing with satellites for either peaceful or military purposes.





TRAJECTORY (left) duplicates re-entry environmental conditions on model scale, keeps re-entry body in range of detection gear. Spin-stabilized launch tube (right) retains attitude it had at launch. Scout vehicle (below) will carry ablation noses with ablation sensors to study relationship of nose cone materials to intensity of ionization which forms around re-entering body. Ionized sheath increases radar echo but makes interpretation more difficult; it reflects transmission of telemetry signals if frequency is too low.



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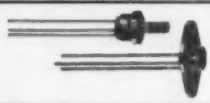
JAN TRANSISTOR		Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum I_{co} @ 25°C and V_c Max. (μa)	FEATURES
	JAN-2N118	10	30	10	1	• Only Jan Silicon Transistor

SMALL SIGNAL		Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum I_{co} @ 25°C and V_c Max. (μa)	FEATURES
	2N333	18	45	7	50	• Low I_{co} • Operation to 175°C • 200 mw Power Dissipation
	2N335	37	45	10	50	
	2N480	40	45	11	.5	
	2N543	80	45	15	.5	
	ST905	36	30	10	10	

HIGH SPEED SWITCHING		Typical Cut-off Freq. (MC)	Maximum Collector Voltage (Volts)	Maximum Collection Saturation Resistance (ohms)	Max. Power Dissipation @ 100°C ambient (MW)	FEATURES
	2N1139	150	15	60	500	• High Frequency Operation • Low Saturation Resistance • Low I_{co}
	2N337	20	45	150	50	
	2N338	30	45	150	50	

MEDIUM POWER		Max. Power Dissipation @ 25°C Case (Watts)	Maximum Collector Voltage (Volts)	Minimum DC Current Gain (B)	Typical Rise Time (μsec)	Typical Fall Time (μsec)	FEATURES
	2N545	5	60	15	.3	.5	• Fast Switching • High V_c • Rugged Construction
	2N547	5	60	20			
	2N498	4	100	12			
	2N551	5	60	20			
	2N1140	3	40	20	.2	.1	

HIGH POWER		Maximum Power Dissipation . . 25°C Case (Watts)	Minimum DC Current Gain (B)	Typical Collector Saturation Resistance (Ohms)	Maximum Collector Voltage (Volts)	FEATURES
	ST400	85	15 @ 2 Amps	1.5	60	• High Current Handling Ability • Low Saturation Resistance • Rugged Construction
	2N389	85	12 @ 1 Amp	3.5	60	
	2N424	85	12 @ 1 Amp	6.0	80	

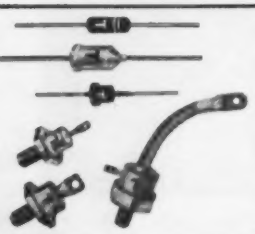
Write for Bulletins: TE-1353 and TE-1355

SILICON DIODES

FEATURES	Fast Switching and High Frequency Types Ratings @ 25°C				Military and High Conductance Types Ratings @ 150°C			
		Max. Inverse Voltage (Volts)	Max. Average Fwd. Current, (ma)	Inverse Recovery Time (μsec)		Max. Inverse Voltage (Volts)	Max. Average Fwd. Current (ma)	Max. Inverse Current (μa) @ V
• Recovery Times Under 15 μsec • High Conductance Combined With Fast Switching • Subminiature Size • High Inverse Resistance	1N808	100	100	.3	JAN 1N457	60	25	5 @ 60
	1N809	200	100	.3	JAN 1N458	125	25	5 @ 125
	1N658	120	200	.3	JAN 1N459	175	25	5 @ 175
	1N659	55	100	.3	1N485B	180	50	5 @ 175
	1N643	110	100	.3	1N488A	380	50	25 @ 380
	JAN 1N251	30	75	.15	1N464	175	40	30 @ 125

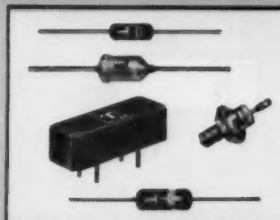
Write for Bulletin TE-1350

SILICON RECTIFIERS

Ratings @ 150°C Case Temperature			Peak Recurrent Inverse Voltage (Volts)	Maximum Average Forward Current (ma)	Maximum Inverse Current (ma)	FEATURES
	Subminiature Glass	1N689 1N649	600 600	150 150	0.2 0.2 (@ 25°C)	• Reliability at High Temperatures • High Efficiency • Rugged Construction • Hermetic Sealing • Low Thermal Resistance
	Miniature	TJ60A TJ30A	600 300	200 200	0.5 0.5	
	Axial Leads	SL715 1N547	1500 600	100 250	0.2 0.3	
	Military	JAN 1N256	570	200	0.25 (@ 135°C)	
	Stud Mounted	TM155 TM67	1500 600	400 3000	0.5 0.5	
	Medium Power	TR402 TR601	400 600	Amps 20 10	5 5	
	High Power	TH402B	400	50	15	

Write for Bulletin TE-1351

SILICON REGULATORS AND REFERENCES



	Voltage Range (Volts)	Maximum Dynamic Resistance (ohms)	Maximum Current @ 25°C (ma)	Maximum Current @ 125°C (ma)	FEATURES
Subminiature — SV-5	4.3-5.4	55	50	10	• Long-term stability • Operation up to 150°C • Small size, easy mounting • Hermetically sealed
Miniature — SV-815	13.5-18	120	40	8	
Power — SV-924	20-27	8	55°C (amps)* .4	(ma)* 100	
Stabistor — SG-22	.64	40	150	25	
Reference — SV-3176	8-8.8	15	Temp. Coefficient ±.001%/°C		
Ref-Amp — 3N44	8.3-9.8		±.002%/°C		

*Case temperature ratings

Write for Bulletin TE-1352

SILICON CAPACITORS

	Ultra High Frequency Types — Ratings @ 25°C						FEATURES
	Cut-off Freq. (mc)	Capacity (μμf) @ V Max.	@ −0.1V	Q @ −4V @ 50Mc	@ 100Mc	Maximum Working Voltage	
SCH-51	5000	.35	2	100	50	10	• Subminiature Size • High Q • High Temperature Operation
SCH-52	5000	.8	4	100	50	7	
	High Frequency Types						
				Q @ −4V At 5mc	At 50mc		
SC-1		4.4	24	350	35	22	
SC-5		25	120	350	35	11	
SC-15		120	360	350	35	6	

Write for Bulletin PB-45

GERMANIUM DIODES

FEATURES

- Milli Microsecond Switching
- Superior Forward Conductance
- High Inverse Resistance
- Uniformity and Stability
- Gold Bonded Construction

Specifications and Ratings at 25°C	Forward Current @ +1V (ma)	Inverse Current at Specified Voltage (μa @ V)	Max. Oper. Voltage (volts)	Description
JAN-1N270	200	100 @ −50	80	JAN TYPES
JAN-1N277	100	250 @ −50 @ 75°C 75 @ −10	100	
JAN-1N281	40	500 @ −50 30 @ −50	60	
JAN-1N126	5	500 @ −50 30 @ −10	60	
JAN-1N198	5	250 @ −50 @ 75°C 75 @ −10	50	
1N283	200	20 @ −10	20	COMPUTER TYPES
T16G	40	100 @ −50	60	
1N278	20	125 @ −50 @ 75°C	50	HI-TEMPERATURE TYPES
T22G	40	20 @ −10 @ 75°C	15	
T9G	100	20 @ −50 2 @ −10	60	HI-RESISTANCE TYPES
1N67A	5	50 @ −50 5 @ −5	80	
T8G	100	20 @ −100 5 @ −10	100	
S570G	10	30 @ 6	Recovery Time .002 (μsec)	MILLI-MICROSECOND SWITCHING

Write for Bulletin TE-1300 & TE-1319

GERMANIUM COMPUTER TRANSISTORS

	Minimum Current Gain (β)	Maximum Collector Voltage (volts)	Typical Cutoff Freq. (MC)	FEATURES
2N427	40	15	8	• High FrequencySwitching • Low Saturation Resistance • Uniform Input Characteristics
2N428	60	12	13	

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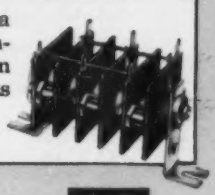

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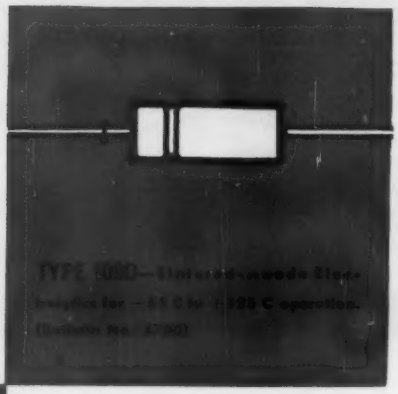

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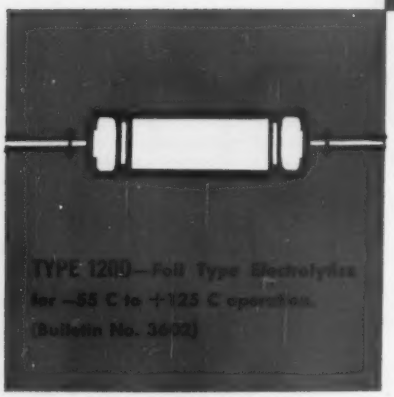

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angle that would carry the rocket farther from the populated areas near the launch site early in the trajectory, so the angle must be a compromise between safety and experiment requirements. Azimuth also is critical because of the small look angle of the detection equipment.

Shortly after the velocity package—which consists simply of a tube with an open bottom end and the three downward-facing rockets—passes the top of the trajectory, the rocket nearest the upper end of the tube fires. This is a Thiokol T-40 which NASA has given a special torque nozzle to increase the spin rate from the 10 cycles per second imparted by the Lance fins to 30 cps.

Next stage to fire is a T-55, and the final rocket engine, which also serves as the re-entry body, is the spherical motor. Velocity of about 16,000 mph. is achieved from about 160 mi. altitude down to about 30 mi. NASA will not say at what altitude the re-entry body becomes visible to the various detecting devices but said this visibility occurs at about 340 sec. after launch.

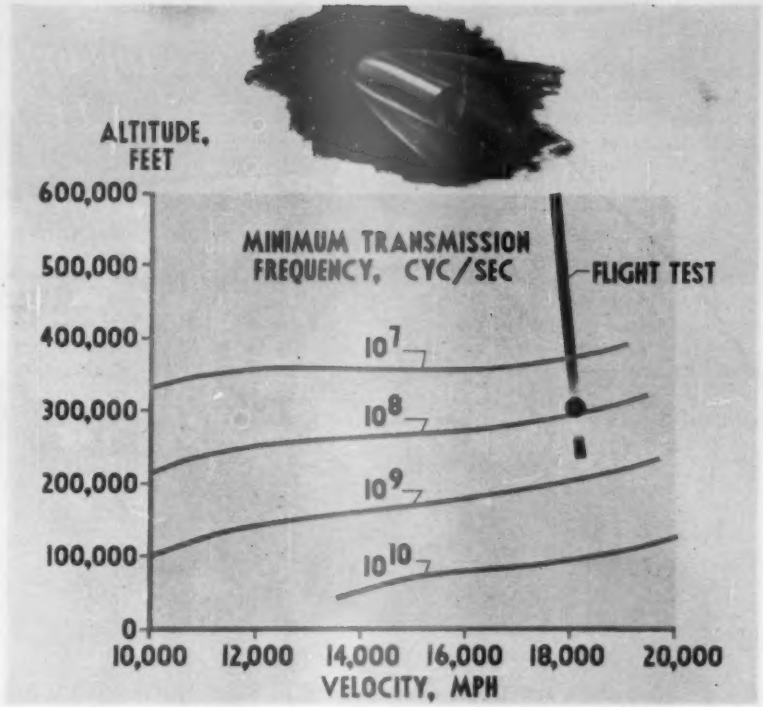
Ionization

Heat generated by the sphere's passage through the atmosphere ionizes the air and produces a sheath of plasma around the vehicle and in a trail behind it. Theory on the parameters of this sheath were considered inadequate and the firings are being made to produce experimental data.

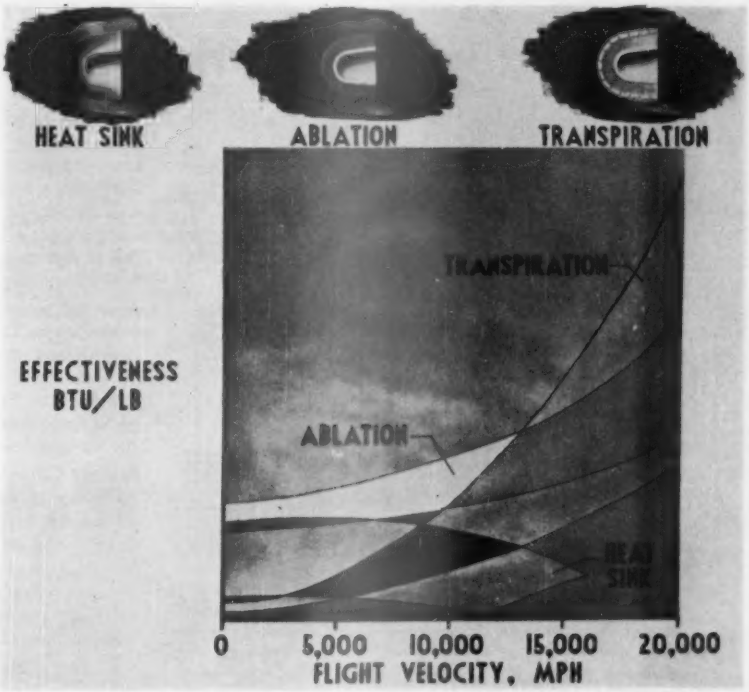
Two rockets have been launched thus far, primarily to check vehicle performance, but useful experimental data already has been obtained and has been checked by ground experiments. On at least one shot, the spherical motor had a transmitting antenna attached to its nose to determine the effects of the plasma sheath on radio transmission.

Transmission through plasma was checked on the ground by enveloping the same antenna in a cyanogen plasma jet developed by NASA, and a relationship has been found between the transmission frequency and the frequency of the plasma. Plasma frequency depends upon the density of electrons. For low-density plasma, transmission will penetrate the plasma sheath as long as transmission frequency is sufficiently greater than plasma frequency. When transmission frequency is sufficiently greater than plasma frequency, there apparently is no diminution in the power of the signal transmitted. The antenna was installed originally on the spherical motor only as a tracking aid. Results of the firing led NASA to suggest that it might contribute to re-entry detection work. Location of the antenna on the body also affects transmission.

Approximately 13 more vehicles will be fired in the current series, under



PILOT of theoretical frequencies at which transmission from re-entering body is stopped by surrounding plasma sheath was verified in ground experiments, agreed with flight test results for telemeter frequency of 109 mc. On this basis, experimenters hope application of simple theoretical approach will lead to understanding of phenomena.



EFFECTIVENESS of various cooling methods and materials for bodies re-entering atmosphere is being studied to see what influence heating has on density of ionization around the body. Chart shows that transpiration method becomes more effective with increase in velocity, but it carries weight penalties. Ablation combines heat sink and transpiration techniques, looks most promising.

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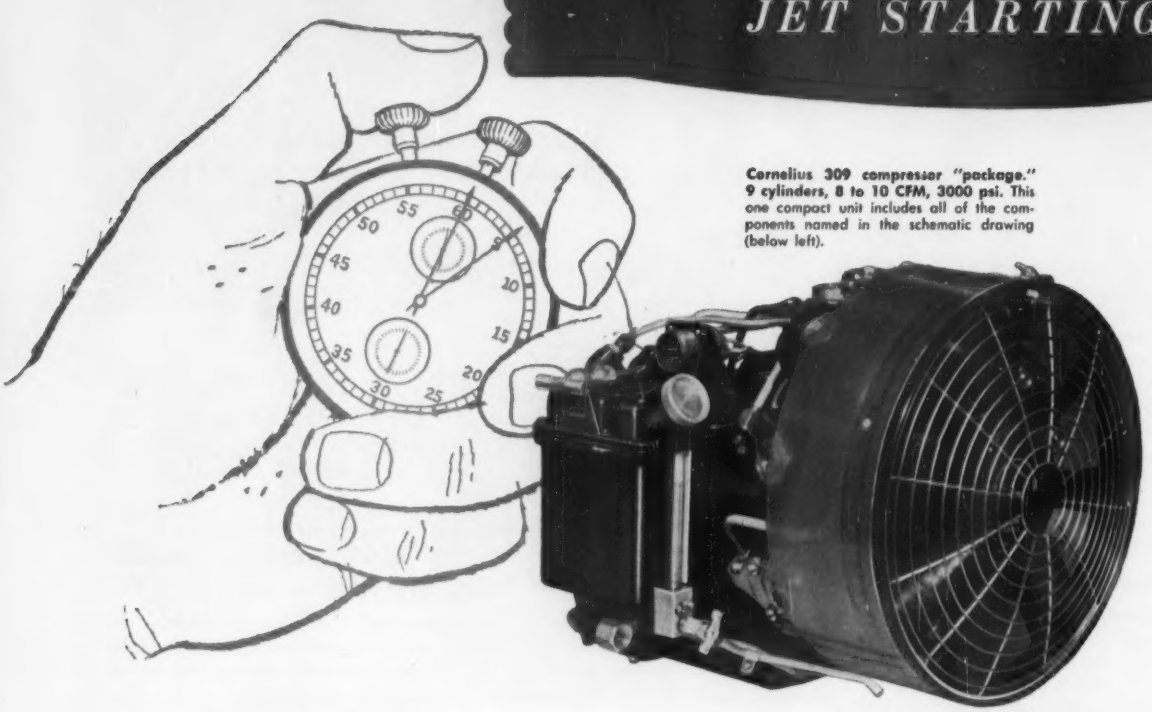
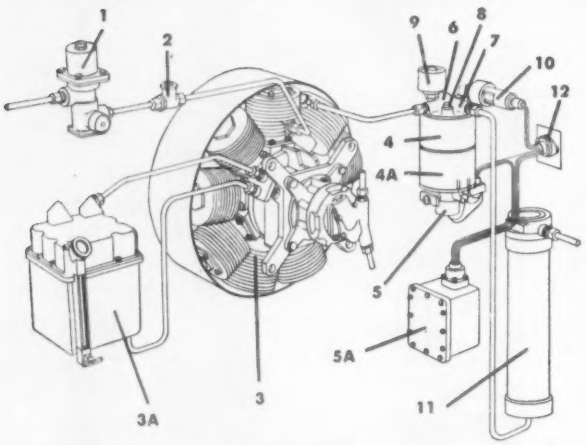
JET STARTING



Cornelius 309 compressor "package." 9 cylinders, 8 to 10 CFM, 3000 psi. This one compact unit includes all of the components named in the schematic drawing (below left).

for reliable "split-second" jet starting equip your jets with Cornelius compressors



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present plans. This can vary downward or might vary upward considerably, depending on what is learned during the early shots.

Next launch is awaiting the installation of detection instrumentation by the Lincoln Laboratories of Massachusetts Institute of Technology. The whole radiation spectrum will be studied, chiefly with Lincoln Laboratories' instruments. The work is being sponsored by Defense Department's Advanced Research Projects Agency.

Variables affecting the detectable phenomena produced by re-entry are suspected but not entirely known or understood. They appear to include velocity, size, shape and material of the re-entering body and may include angle of entry, angle of attack, etc. They also include electron concentration in the atmosphere, so that precise measurements of this concentration are necessary.

Radiation output of the multiple frequency radars being used in the detection work is high enough that they had to be located on the Virginia mainland west of the island which the launchings are made.

Telemetry and optical stations will be located north and south of the launch site on the Virginia coast. Ships will not be used because stations must be located with higher precision than ship-based instrumentation can attain.

The NASA portion of the work is being directed by David G. Stone, head of the Pilotless Aircraft Division's Flight Physics Branch; William N. Gardner, head of the division's Systems Application Section, and Russell Hopko, of its High Temperature Materials Branch.

NASA intends to stay with solid rocket propellants, varying the propulsion system and weight of the re-entry body to achieve speeds into the meteoric range. Then the name that has been used informally for this work may be applied seriously—Project Meteor.

Military Use Seen For Base on Moon

Los Angeles—Lunar missile base will give back to the soldier time and room for battle of which he has been deprived by advancing technology. Robert L. Johnson, Douglas Aircraft Co. chief engineer for missiles and space systems told the Society of Automotive Engineers here.

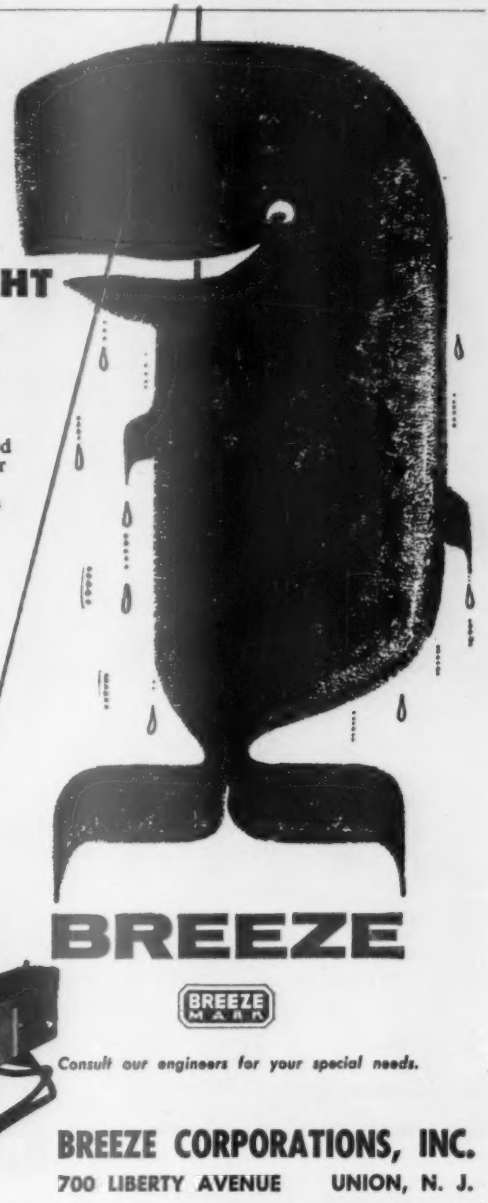
Offensive technology has so far outstripped defensive technology that the ability to retaliate will soon be in doubt for bases upon the earth.

"There's a debate of long standing as to the relative merits of burying missile launching sites deep in the ground as a defense against enemy atomic bombs," Johnson said. "There is also the question of meeting the threat of surprise attack by dispersing such large numbers of ever-alert strategic missiles or making them sufficiently mobile so that their survival to retaliate would not be subject to doubt. Such arguments may eventually be resolved with a moon station which would pose a threat of inevitable retaliation. The station would have many hours to assess the threat and respond with devastating power."

Johnson did not attempt to minimize the costliness of a lunar missile base. However, he said, "if low cost were the main object in weapon delivery systems we would crate warheads and mail them."

He noted that missiles and space vehicles deriving from common ancestors are developing widely different characteristics. This divergence stems from differences in mission. One important difference is that in space vehicles the designer must always strive to maximize performance while the maximum performance required of a ballistic missile is limited by the size of the earth, decreasing size and weight of warheads, and conflicting military requirements of quick reaction, transportability, simplicity of operation, and quantity production. These requirements and the

Lightweight HOISTS reel in HEAVYWEIGHT Loads!



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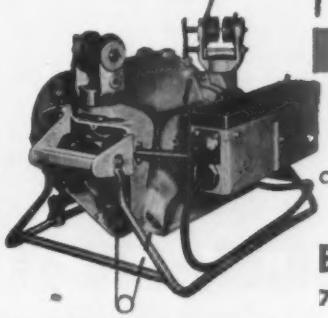

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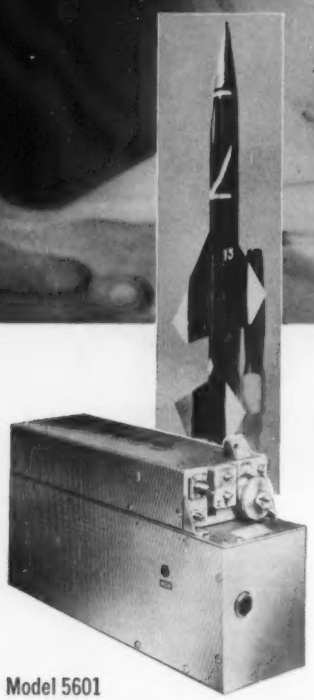

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one-shot nature of the ballistic missile mission cause a trend toward smaller size and the use of solid propellants.

Space vehicle payloads must be as large as possible and there is no limit to the range at which they may be required to operate. Both these factors dictate the trend toward larger and larger vehicles. Their size is limited only by the technology and economy which must support them.

Maximum performance calls for the use of liquid propellant. Reusability is necessary because of the high cost of the vehicles and since they are manned they must be recovered anyway. Rate at which space vehicles will be launched will be very slow compared with the rate of launching ballistic missiles in a combat situation, so skill levels of launching crews can be much higher.

Progress of Air Materiel Command programs for development of techniques of extruding pure beryllium and high temperature steel was outlined by Lyle M. Christensen of Norair Division, Northrop Corp., holder of prime contracts for both programs. Programs have run for about a year and are scheduled to run for another year.

Both are based upon a survey of airframe and extrusion company groups. Christensen reports that there has been much transfer of results between the two programs since both materials are extruded in about the same temperature range and both use glass as a lubricant. Airframe industry survey results show that it is ready and eager to use steel extrusions.

Material selected for Phase 1 steel extrusion program are H-11 grade (5% chromium hot work die steel) and A-286 temperature resistant ferrous alloy. Subcontractors chosen to push experimental extrusion during Phase 1 were:—Allegheny Ludlum Steel Co., Harvey Aluminum, and CIEPM of France. Participant who most nearly meets target specification will be chosen for a pilot production run.

Shape extruded in the development program is a T-section with cap and web both 1.5 in. wide and .06 in. thick. Typical aluminum tolerances were specified. Development portion of the Phase 1 program has been extended with Allegheny Ludlum as a single source. Norair and Allegheny believed they were close to a major advance in technique when the steel strike interrupted the program.

Material selected to begin the beryllium extrusion development program was sintered pure beryllium powder billet made of −200 mesh powder which was chosen because very little data exists on mechanical and physical properties of any other form of beryllium which can be converted into extrusion billets. Cast beryllium and beryllium alloys now in development will be studied later in the program. Shape to be extruded was a channel section with .12 in. thick segments.

Developmental extrusion billets cost more than $100 per lb. because of the high price of raw beryllium and high cost of processing. Decreases in Atomic Energy Commission purchases of beryllium have reduced production and raised the price of AEC standard material to a level comparable with commercial beryllium. Price reductions can be expected as more beryllium is used.

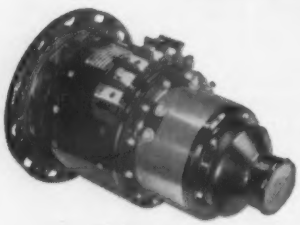
To conserve material, one participant in the current program backed up the beryllium billets with a less expensive alloy which was partially extruded in each push. This eliminated billet butt scrap. Toxicity of beryllium is a problem seldom encountered with other materials, but air samples in the work areas showed very litle increase in beryllium content. Developmental extrusions were made in two stages: first, round rods with a cross-sectional area equal to that of the channel shape were pushed, then the rounds were extruded to the channel shapes. Christensen reported that the feasibility of bare beryllium extrusion has been indisputably proven.

Ground support equipment for GAM-77 Hound Dog air-to-surface missile was described by E. B. Price of North American Aviation. North American developed operational ground support equipment concurrently with the development of the missile. The equipment coming out of this program was used to support missiles built for the development test program and some items are being used in factory and test departments.

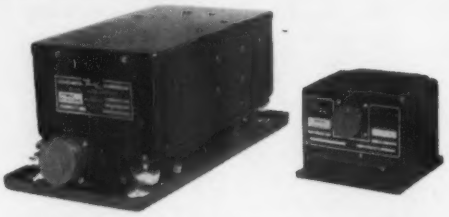
Atlas Nose Cone Photos Combined

Composite of photographs taken from a General Electric Mark II heat sink nose cone aboard a USAF Convair Atlas intercontinental ballistic missile spans the Western Hemisphere from the northern U. S. to the Caribbean Sea and the coast of South America (AW Sept. 14, p. 124-125). Weather fronts and atmospheric circulation can be discerned. The missile was launched from Cape Canaveral, Fla.

HIGH TEMPERATURE AC GENERATING SYSTEMS

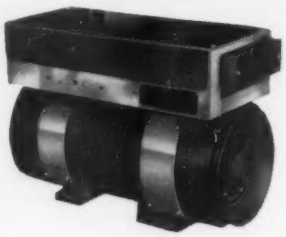


AC Generators

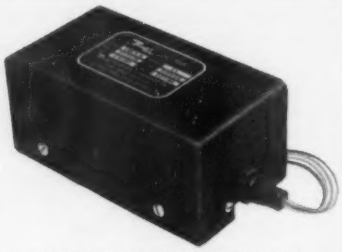


AC Voltage Regulators and SYSTEM COMPONENTS

SPECIAL ENVIRONMENTAL FREE INVERTERS



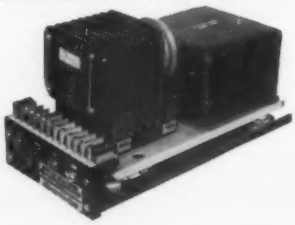
HIGH-ALTITUDE AND MISSILE INVERTERS



STATIC AC AND DC POWER SUPPLIES

HIGH TEMPERATURE DC GENERATING SYSTEMS

DC Generators



DC Voltage Regulators and CONTROL PANELS

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Test Pilots Stress Man's Space Role

Los Angeles—Federal Aviation Administrator E. R. Quesada told the Society of Experimental Test Pilots that "one reason for the high failure rate in our missile and space probes to date is the fact that we have not been able to put a pilot in them to nurse them along, and to compensate for their electromechanical idiosyncracies."

Speaking of the future of aviation and test piloting, Quesada said "we now face the whole new era of maneuverable space vehicle flying, the first test of which is the X-15, to be followed by a whole series of other types of space vehicles.

"As soon as our unmanned vehicles have probed and reported more of the unknowns of space flight, and as soon as we can get man in these later space vehicles, our progress in space exploration will increase much more rapidly."

Quesada's statement apparently reflected the opinion held by the nation's top test pilots, most of whom were here for the three-day symposium on "The Pilot's Role in Space Exploration."

There was general agreement that the complicated spacecraft of the future will need man to monitor the many systems during their operation, if not to actually operate them in all cases.

Capt. Donald K. Slayton, Mercury astronaut and member of the Society, said the reason man, and specifically an experimental test pilot, will be sent into orbit is that in any scientific endeavor, the individual who can collect a maximum of valid data in minimum time under adverse circumstances is highly desirable. He said the entire Project Mercury man-in-space mission can and will be accomplished without the astronaut aboard and if everything goes well, including autopilot and automatic sequencing, there will be little for the pilot to do.

In the case of this perfect flight, the astronaut will "devote the entire time of flight to observing and analyzing his and the vehicle's reaction to space travel and should return with an excellent idea of man's capabilities in a space environment. If a chain of failures should occur, as usually happens, such as pressurization, autopilot, communications and flight instrument difficulties, the task would become quite complicated but not beyond the pilot's capabilities and we would have an even better idea of man's abilities in space."

Slayton said the first Mercury mission will call for three orbits and will take approximately 4½ hr. During orbit it is expected that the astronaut will be able to observe the earth through either a periscope or a window placed in the capsule. Also projected is a 27-hr. flight involving 18 orbits of the earth during which, if all goes well, it is expected that the astronaut may get some sleep. With this in view, both visual and audio warning of malfunctions will be provided.

Slayton said "I am personally convinced today's pilots can effectively perform all functions necessary to safe and efficient space travel."

Operational aspects of Project Mercury were described by Christopher Kraft of the Space Task Group at Langley AFB, Va. An orbital inclination of 32½ deg. with a northeast launch from Cape Canaveral, Fla., has been chosen to provide a track which permits the use of existing tracking stations throughout the world. It will also enable the Atlantic Missile Range to be used as a launch and recovery area, and will provide an orbit which remains over the continental U. S. for a considerable time to allow continuous tracking. Orbit also will remain over friendly territory and within the temperate zone of the world.

Astronaut Recovery

Every effort will be made to recover the Mercury astronaut in the Atlantic Ocean. Kraft said that if sufficient velocity is not achieved on launch to permit at least 1½ orbits, retrorockets will be fired immediately and the mission aborted. Recovery therefore could be effected in the Atlantic by helicopter and/or surface vessel rather than permitting an impact on Africa.

If sufficient velocity is achieved for 1½ orbits, but not enough for three or more, then one complete orbit will be allowed and the retrorockets fired upon its completion. Goal, however, is to permit a maximum of three orbits on the first attempt. Altitude of the three-orbit mission will be about 105 naut. mi. Altitude on the 18-orbit mission will be 120 to 125 naut. mi.

If, due to unforeseen circumstances, the re-entry and recovery cannot be effected in the Atlantic, air and sea rescue units throughout the world will be depended upon.

Project Mercury, if it were to be placed in one of five categories of national interest problems, i.e., economic, political, psychosocial, military or scientific-technological, must surely be placed in the political category, according to Col. Charles H. Roadman, USAF (MC) chief of the Human Factors Division, directorate of research and development. He said the U. S. is lagging behind Russia not only in space exploration but in the exploitation of space achievements. The political significance of scientific-technological achievements makes the latter a force with significant international implications.

In his speech, titled "Space Race—Plan or Panic," Roadman said it has been difficult for our top national planners to identify our goals because of the complexity of the space age. He suggested that we should perhaps concentrate on being the first to Venus or Mars, in view of the Russian achievements in lunar exploration. Russia has been able to turn a recent moon im-

XV-3 Pilot Wins Kincheloe Award

The Iven C. Kincheloe award for the most outstanding experimental flight test work during the previous year has been awarded to Maj. Robert G. Ferry of Edwards AFB, Calif. Ferry was honored for his work in testing the Bell XV-3. Although not directly related to his work as experimental test pilot at the Air Force Flight Test Center, he has performed many hazardous flights rescuing downed pilots and stranded campers in the high Sierras.

Mrs. Dorothy Kincheloe, widow of Capt. Kincheloe, presented the award to Maj. Ferry on behalf of the Society of Experimental Test Pilots.

Honorary fellowships were awarded by the Society to:

- E. D. "Sam" Shannon, chief of flight research, Convair, for development test flying of such aircraft as the Martin B-10, B-26, PBM3 and Mars, and Convair's PB4Y, A-31, Convair Models 110, 240, 340 and the XF2Y1 Seadart.
- William H. McAvoy, retired from National Advisory Committee for Aeronautics in 1957, for early systematic testing of autogyro and helicopter aircraft and many other contributions while a test pilot at NACA, Langley Field (1920-1940), and chief test pilot, NACA's Ames Laboratory (1940-1957).
- Maj. Alexander P. de Seversky, founder of Seversky Corp., which later became Republic Aviation, for early design and testing of a series of fighter aircraft which culminated in the P-47. He also was lauded for his contributions to the advancement of air power.

Advancement to grade of fellow was bestowed to Charles Tucker, Lockheed Aircraft Corp., Jackson G. Armstrong, formerly of Douglas Aircraft, and Fred S. Chamberlain, Curtiss-Wright Corp.

Soviet 'Cosmonauts,' Dogs Participate in Space Research

Russian magazines "Ogonyok" and "Soviet Union" this month carried details of work being done on the Soviet man-in-space program. Russian "cosmonauts" are reportedly training at an undisclosed site with facilities including an altitude chamber, decompression cabin and centrifugal accelerator. Technical details were sparse. Russian "cosmonaut" in left photo receives final instructions before a test. At right, a female dog named Gypsy, clad in pressure suit, is shown after an altitude chamber test. Soviets have used dogs in altitude chambers with and without pressure suits. In one experiment the Russians took a dog to a simulated high altitude, without a pressure suit, until the animal's blood went into vacuum boil and its skin expanded. After the experiment the dog walked out, apparently normal. "Boiling does not bring harm to the animal if it does not last long," the Ogonyok article said. "In laboratories the state of negative gravity lasts only from 1 to 2 sec.," Soviet Union magazine said. Experiments with animals launched into space "give some reason to consider that the state of negative gravity, by itself, will not violate basic psychological functions of the human body—besides, with the help of technical means it is possible to create (artificial) gravity in a cosmic cabin."

pact feat into an important advantage in international trade by implying that if they can make a rocket hit the moon, they can do anything, he said.

Roadman also suggested that one of the astronauts should be sent into space as soon as possible so that the U. S. could score a beat on Russia.

Dyna-Soar (DS-1) probably will undergo flight testing similar to the North American X-15 program in the preliminary stages, according to Lt. Col. Harold Russell, head of the Manned Spacecraft Section at the Air Force Flight Test Center, Edwards AFB. He also said the Dyna-Soar glide re-entry vehicle probably will be air launched from a Boeing B-52 for preliminary glide landings at Edwards, as has the X-15. A recoverable first-stage boost for Dyna-Soar may also be provided by using a North American B-70 for an air-launching vehicle.

Russell also said the decision on the contract award between the Martin-Bell team and the Boeing team has been made by the Air Force but not yet announced. Selection of pilots for Dyna-Soar is under way from among the ranks of Air Force and NASA pilots. The selection process is similar in some respects to the extensive screening for Project Mercury.

Ability of a pilot to control a hypersonic glide re-entry vehicle was discussed by E. V. Marshall, Dyna-Soar project manager, Astronautics Division of Chance Vought Aircraft. Marshall said simulator studies showed that pilots with a moderate amount of simulator training can successfully manage the kinetic energy of a re-entry-type glide vehicle. Energy management, a fairly new term in pilot language, is concerned with properly expending the potential and kinetic energy of a manned aircraft so that a safe landing at a predetermined point can be effected. Potential energy which is due to the aircraft's altitude may amount to one-half million foot pounds per pound of vehicle weight at an altitude of 500,000 ft. However, kinetic energy of a hypersonic vehicle may amount to 20 times the potential energy or 10 million foot pounds per pound of vehicle weight.

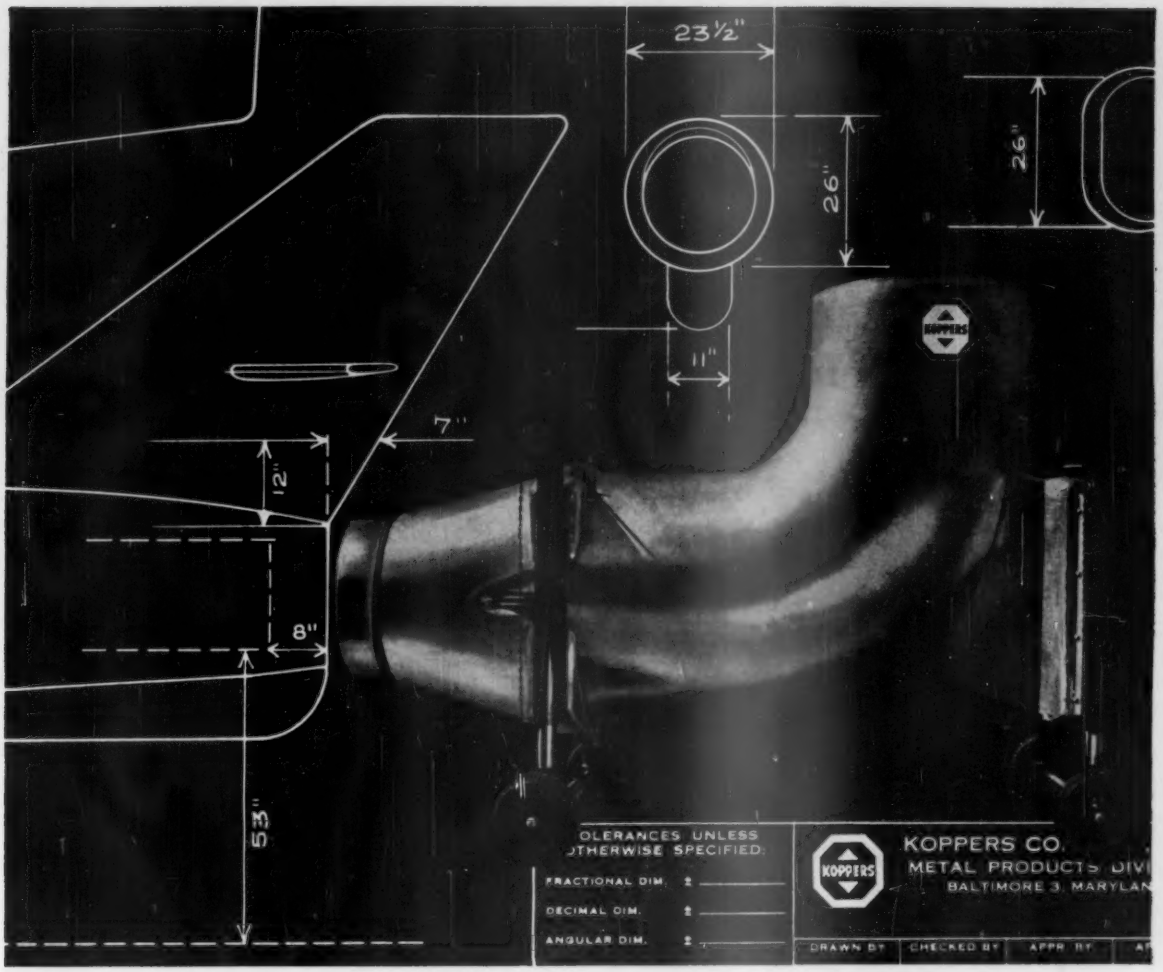
Providing a simulator which will afford fairly realistic training in energy management to prevent the structural and temperature limits of a re-entry vehicle from being exceeded will cost approximately $8.9 million, Marshall said (AW Apr. 20, p. 56).

New approach to power-off landings which may be applied to a Dyna-Soar-type vehicle were described by Fred J. Drinkwater, experimental test pilot with NASA's Ames Research Center. Instead of a traditional 360-deg. overhead approach, the new technique, investigated by NASA using an F-104A, consists of a straight-in dive bombing type of approach to the runway. Advantages claimed by Drinkwater for this type of approach are that greater landing accuracy can be achieved and altitude from which the approach is started is not so critical as in the 360-deg. overhead type.

Technique consists of diving the aircraft at a preselected point in line with the runway centerline. During the tests, the aiming point as well as the dive angle was varied but in each case it was planned so that when pull-out was completed, the normal bleed-off rate of airspeed would permit the aircraft to be at landing speed when over the touchdown point.

Altogether, 30 approaches were made in which a predetermined landing point was hit within 600 ft. while airspeed was within 10 kt. of that predicted. Approaches were made with gear and flaps up at 450 kt. and with gear handle down at 300 kt. Airspeed was varied by the use of speed brakes.

Altitude at which the power-off landings were commenced varied from 15,000 to 20,000 ft. and no external guidance other than pilot reference to the ground was used. All landing were accomplished in less than 6,000 ft. without the use of a drag chute.



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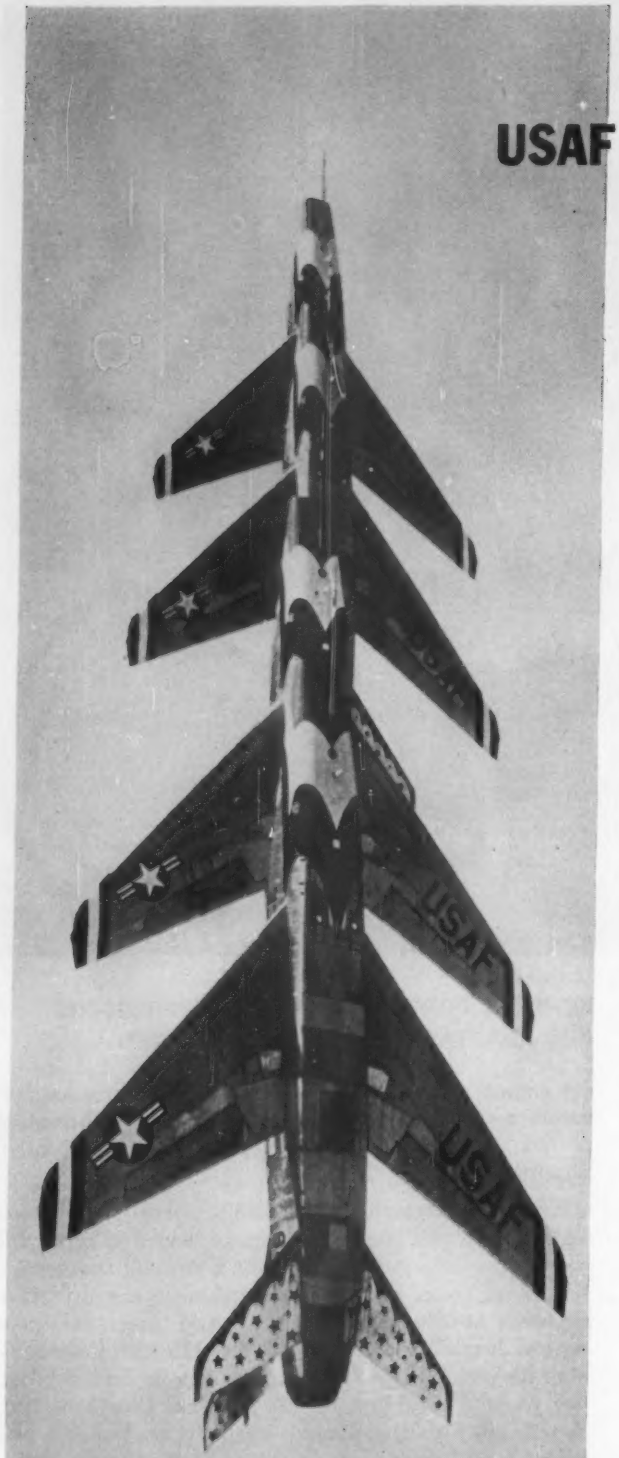

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USAF Thunderbirds

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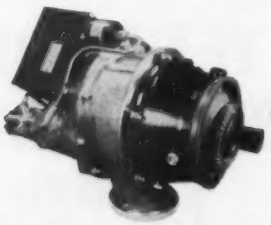
Field reports like these reinforce one of the outstanding starter records in the industry. Over 14,000 Hamilton Standard starters . . . pneumatic and fuel-air . . . are in service today on 27 types of front-line aircraft. That's experience you can count on.



Model FAS-450-9. Weighs 44 lbs. Delivers 150 hp. Starts Thunderbirds' J-57P-21 engines (16.3 slug ft.^{2} moment of inertia) in 10 seconds. Complete data available on request.

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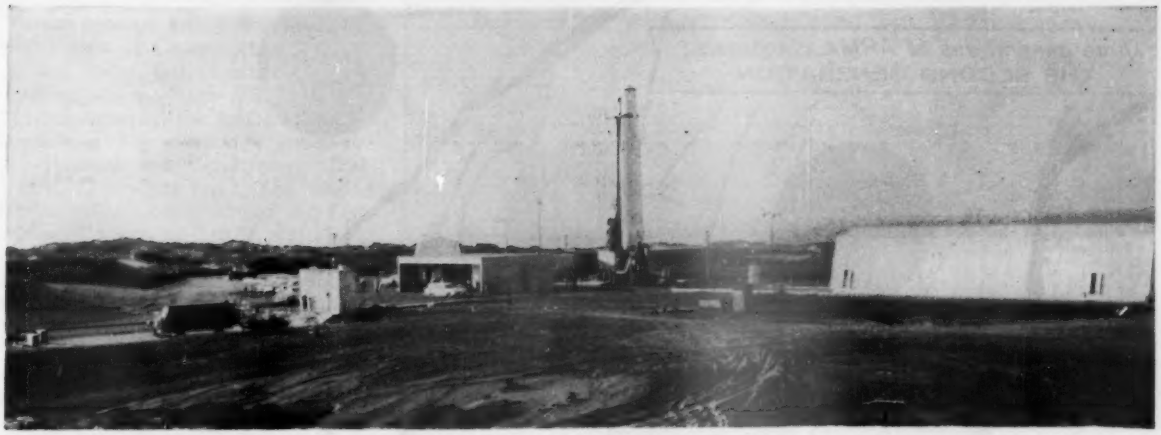

THOR IRBM is erected to firing position at Vandenberg AFB, Calif., where USAF is training operational ballistic missile crews.

Vandenberg Trains USAF Missile Crews

By William S. Reed

Vandenberg AFB—Operational training for U.S. Air Force and Royal Air Force missile crews is being conducted on a round-the-clock basis with live firings of Atlas and Thor ballistic weapons from this West Coast Strategic Air Command base. Scheduled for the future are firings of Titan missiles from underground silos, construction of the first of which will be completed in January, 1960.

Developing concurrently with the training program for Atlas is what missilemen here call the emergency war operation capability. That this base has an operational capability was demonstrated early in September with the first firing of an Atlas missile by an all-USAF crew (AW Sept. 14, p. 32).

Vandenberg AFB is not a western counterpart of Cape Canaveral, Fla., nor is it a highly instrumented stepping-off point for the exploration of outer space. It is being constructed and will be manned for the purpose of providing operational training and, in emergency, for launching intercontinental ballistic missiles, according to First Missile Division Commander Maj. Gen. David Wade.

Prime Mission

Wade says Vandenberg AFB is no more like Cape Canaveral than Edwards AFB is like San Diego Naval Base, a comparison he uses to point out that the prime mission here is operational training. Support of space programs, such as the Discoverer series, is secondary to the main Strategic Air Command mission.

To provide this base with the facilities which will make it to missiles what Randolph Field was to the airplane, the Air Force has allocated funds in the amount of $178,607,000. At the end of September, $83 million already had been paid or committed on contracts.

Of the total amount allocated, slightly more than $120 million will be spent for direct support of Atlas, Titan, Thor and space programs.

More than $32 million will be spent on support facilities such as airfield improvement, construction of instrumentation facilities, and the rehabilitation of office buidings, classrooms, etc.

Remainder of the funds, administered separately and amounting to approximately $25.5 million, are directed toward construction of 1,800 family dwellings, 1,400 of which are completed to date. Not included in the above amount is $3.5 million in Air Defense Command funds for con-

Maj. Gen. David Wade

Maj. Gen. David Wade has commanded the First Missile Division at Vandenberg AFB since January, 1958. During this time, he has seen the Atlas training program grow from its inception in March, 1958, to the first limited operational capability launching.

Wade was born in Minden, La., in 1910 and entered the Air Force as a cadet in 1935. He was first assigned to Strategic Air Command after a tour of duty as vice commander of USAF Security Service, which ended in 1950.

One of his first SAC commands was the 98th Bombardment Wing whose mission was bombing strategic targets in North Korea. He commanded various SAC units until he became deputy inspector general for SAC headquarters in 1955. He became SAC chief of staff in September, 1956.

When asked about the recent Department of Defense decision whereby the Air Force was given the bulk of the missile programs in the future, he said he is "glad the Air Force got the job since they have done 90% of the work on ballistic missiles to date."

As for the mission of Strategic Air Command, Wade says, "with 18% of the defense budget, SAC has 90% of the deterrent mission and in that respect, the taxpayer is getting a good job for the money."

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struction of a Bomarc B unit, which now is under construction.

Transforming this 64,000-acre former armored and infantry training site known as Camp Cooke into the United States' first operational missile training site has been going on since the activation of the first USAF unit in July, 1957. Originally under the Air Research and Development Command, Vandenberg was turned over to Strategic Air Command and the First Missile Division on Jan. 1, 1958.

Impact on the local economy has been considerable since base personnel spend about $4.25 million per month in the surrounding communities.

Lompoc (1955 population 5,520), about eight miles distant from the base, showed Fiscal 1959 increase in taxable sales from $4.9 million to $11.6 million. Santa Maria, 14 mi. from Vandenberg, but with twice the population of Lompoc, showed a nearly twofold increase in taxable sales, $17.3 million vs. $33.9.

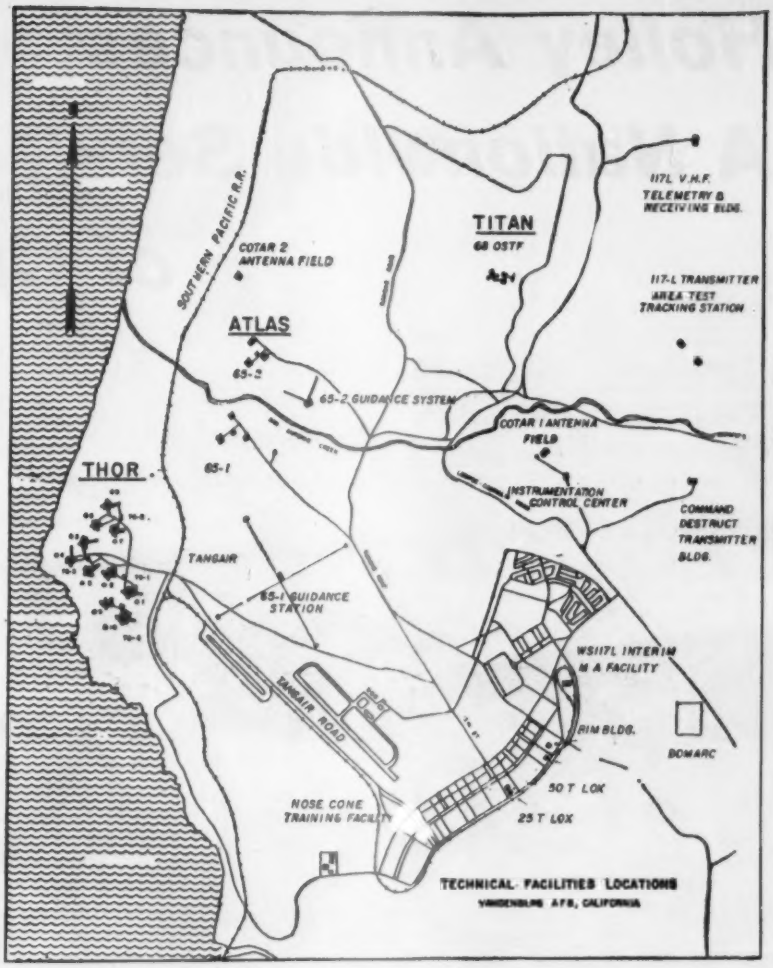
Facilities Available

In terms of facilities, this provides:

- **Six Atlas** launching pads, three of the upright type and three of the "lie-down" type. Upright pads, already completed, are being used for the Atlas training program. Semi-hardened lie-down types are not yet complete. Latter will require less effort on the part of launching crews due to greater ease of maintenance with the missile in the horizontal position.
- **Seven Titan silos,** four of which are about 65% complete. Second set of three silos, started in April, is estimated to be 27% compelte.
- **Ten Thor** launching pads used for training RAF crews.
- **Additional facilities,** more highly instrumented than necessary for operational firings, for support of space programs.
- **Technical support facilities** consisting of range instrumentation, range safety, improved airfield facilities and other housekeeping items.

It was from one of the three upright gantry launchers that the first operational Atlas was fired early in September. SAC missilemen say that launch preparations on the upright gantry are much more difficult than will be the procedure with the missile in a horizontal position. One of the big handling problems is that Atlas cannot support its own weight unless fully fueled or pressurized. In the upright position the missile is suspended from its nose.

In the horizontal position, prelaunch checkout will be significantly improved even though the missile must still be "stretched" while it is lying in its trailer. Access to components for checkout will be easier and later model



ABBREVIATIONS key is: IRSS (instrumentation and range safety system); CDT (command destruct transmitter); COTAR (correlated tracking and ranging); RIM (receipt, inspection and maintenance-Thor); ICC (instrumentation control center); MAB (missile assembly building); SM 65 (Atlas); SM 68 (Titan), and SM 75 (Thor). Liquid oxygen storage facilities are at lower right center, near the Bomarc complex.

missiles, designed for horizontal storage, will have simplified fueling and checkout procedures.

Horizontal launch sites are referred to as semi-hardened since the weapon will be covered by a heavy enclosure prior to the erection and fueling operation. Present manning requires 13 operators to launch Atlas from the gantry but only 12 will be needed in the semi-hardened installation. SAC men predict an even further reduction in personnel requirements as the advancing state of the art permits simplification of the launching procedures.

Construction of the first underground Titan complex consisting of missile silo, equipment terminal facility, propellant storage facility, tunnels, command control center, powerhouse, antenna silo and other related work, was commenced on July 21, 1958. Like other construction work at Vandenberg, contracts on Titan construction have been administered by the Western Area Office of the Los Angeles District, U.S. Army Corps of Engineers.

First complex of four silos, including interconnecting tunnels of approximately 10 ft. in diameter, and the longer main tunnel which will connect the entire complex with an underground command control center, now is more than half complete. Largest of these concrete-lined holes for the missile itself is approximately 40 ft. in diameter by 160 ft. deep.

A Corps of Engineers spokesman refers to the construction of Titan silos, Atlas gantries or other technical facilities as the "brick and mortar" part of the job. Installation of the instrumentation or "jewelry" is not undertaken by Corps of Engineers but is left to individual contractors, or in some cases, to Air Force personnel.

Oldest facility from the standpoint of operation is the10-pad Thor com-

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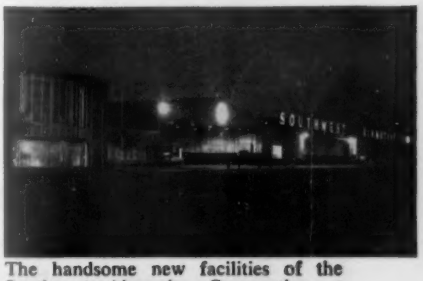

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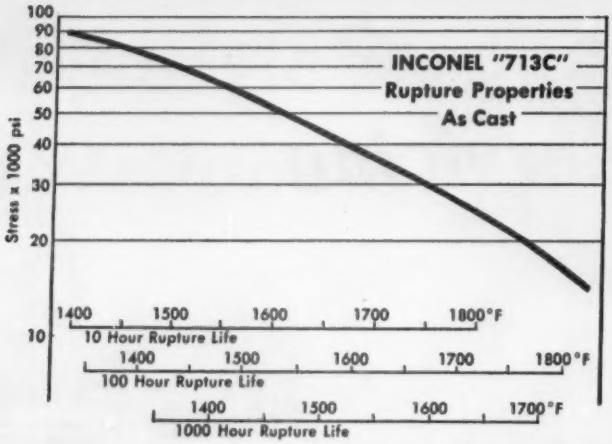

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It was developed especially for high temperature investment cast parts in advanced jet aircraft and missile hardware.

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Other new high temperature alloys

In addition to Inconel "713C", a number of other new high temperature alloys have been developed which may well be the answer to material-selection problems in missile design. They include: Incoloy "T" titanium-containing nickel-iron-chromium alloy, Incoloy "901"* nickel-iron-chromium alloy, Inconel "700"* age-hardenable nickel-cobalt-chromium alloy and Inconel "702"* aluminum-containing nickel-chromium alloy. For comprehensive data on these new nickel alloys, write to:

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U.S.A.F.'s Atlas

INCONEL "713C"

Vandenberg Personnel

(as of September, 1959)

Military (officers and airmen)	5,153
Dept. of Air Force civilians	890
Corps of Engineers (including construction workers)	800
Missile contractor personnel	
Convair	2,084
Douglas	690
Lockheed	577
Martin	199
General Electric	213
American Machine & Foundry	151
Kellogg Switchboard	150
Rocketdyne	103
Burroughs	53
Aerojet-General	34
Total	11,097

plex. First launch from a Thor pad took place in December, 1958. Since then, five other Thors have been launched.

Discoverer launchings also have taken place from the Thor complex, making a total of 12. Thor site probably is the most active in Vandenberg, since it is the scene of continuous Royal Air Force training.

Although Thor is completely RAF-manned insofar as maintenance, erection and launching of the vehicle is concerned, USAF personnel go through the Thor program to provide instructor replacements and to serve with Thor units in England. Main function of USAF personnel is responsibility for the warhead and to "turn the key" which arms the missile (AW July 13, p. 29).

Instrumentation Squadron

Range safety and instrumentation is under the supervision of the 704th Instrumentation Squadron commanded by Col. Lucius A. Perry. Formerly of Cape Canaveral, Perry has seen over 600 missile launchings, and has the weighty responsibility of activating the destruct system if indications are that the vehicle is going astray.

Vandenberg does not have the extensive instrumentation found at Cape Canaveral because the main function here is operational training for Thor and Atlas, requiring only the limited instrumentation necessary for peacetime launchings and operational training.

Supporting research and development efforts are incidental to the mission prescribed by SAC headquarters.

All major components of the 704th's equipment now are installed and in working order. However, a bit more construction remains to be done. The instrumentation is what Col. Perry refers to as "non-standard Air Force" and it was necessary to start from scratch

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Extremely close temperature control is required in the Redstone missile propulsion system. In readiness at launching sites from the equator to the polar regions, heater assemblies, developed by Safeway Heat Elements, Inc., Middletown, Connecticut, are mounted directly on or around components in the propulsion system. These heaters withstand temperature extremes from −80°F. to +450°F., and incorporate a unique "snap-on" mounting feature for ease of installation.

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Vandenberg AFB Satellite Firings

DATE	OPERATING	MISSILE	REMARKS
16 Dec. '58	SAC	Thor	successful
28 Feb. '59	BMD	Discoverer I	orbit
13 Apr. '59	BMD	Discoverer II	orbit, no recovery
16 Apr. '59	RAF	Thor	successful
3 Jun. '59	BMD	Discoverer III	no orbit
16 Jun. '59	RAF	Thor	destroyed in flight
25 Jun. '59	BMD	Discoverer IV	no orbit
3 Aug. '59	RAF	Thor	successful
13 Aug. '59	BMD	Discoverer V	orbit, no recovery
14 Aug. '59	RAF	Thor	successful
19 Aug. '59	BMD	Discoverer VI	orbit, no recovery
9 Sept. '59	SAC	Atlas	successful
17 Sept. '59	RAF	Thor	successful

to build up what was needed. Mission defined for the 704th instrumentation squadron is to:

- **Provide missile flight** safety.
- **Provide missile performance** data.
- **Provide missile-borne** telemetry and command destruct system.
- **Coordinate with service** and civilian agencies.

Provisions for missile flight safety mainly revolve around determining impact lines and developing destruct charts prior to each launch. Impact lines are boundaries in which the missile or its components may fall during the course of a flight. Destruct charts are drawn so as to confine the missile along a three-dimensional track containing a certain margin for error. Deviation from this prescribed track may cause a portion of the missile to fall beyond the predetermined impact lines, cause for in-flight destruction.

Missile performance data gathered is of the limited type such as is necessary to determine success or failure during operational training firings. Gathering of downrange information and determination of nose cone impact is the responsibility of the Pacific Missile Range. Some data gathering may be left to a contractor as in Lockheed's role in the Discoverer firings.

Missile-borne telemetry is not as extensive as that required for research and development firings at Cape Canaveral. Only instrumentation sufficient to tell which subsystem failed, and not necessarily why this subsystem failed, is required for operational training. A small additional amount of instrumentation is necessary during the training launches at Vandenberg beyond what is normally used in an operational missile. It is not nearly as extensive as the instrumentation carried during research and development firings at Canaveral.

Date, time and trajectory of each missile firing is coordinated by the instrumentation squadron with service and civilian agencies. Aside from notifying the internal organization at Vandenberg, coordination is effected with the Pacific Missile Range which in turn is responsible for issuing the necessary warnings, notices and taking normal safety precautions.

One of the most important civilian agencies to be notified, and with which to effect coordination, is the Southern Pacific Railroad, whose main line from San Francisco to Los Angeles runs through the Vandenberg firing area. Generally, firings are scheduled around the passage of trains through the area with only an occasional third-class freight being delayed for a launching. This necessity for firing between trains becomes understandably complicated since only a few of the fast freights and passenger trains run on a predictable schedule.

The Southern Pacific agent who attends each firing in a safety advisory capacity describes the Southern Pacific as an "engineer's railroad." Significance of the term is that the responsibility to make the next siding in order to make way for a faster overtaking train is left up to the engineer rather than to a central coordinating agency.

Safety Reconnaissance

To ensure that the safety of trains is not compromised by a missile firing, Vandenberg mounts aerial reconnaissance missions during the final countdown for each launch. Depending on the availability of aircraft, base pilots fly over the railroad to the north and south of the firing area and communicate to the instrumentation control center the whereabouts of trains in the immediate vicinity. For westerly firings, only a short section of the track need be cleared, but for southerly firings, such as the Discoverer series, the missile flight path traverses or closely parallels a considerably greater stretch of track. Countdowns have been held up in the past because of trains and will probably continue to be delayed in the future, especially if the scheduled launch time is not met.

Instrumentation facilities at Vandenberg include the instrumentation control center, from which point the missile is tracked and to which the data is fed. Command destruct transmitter is also operated and maintained by the instrumentation section. The command district transmitter is completely duplicated in each missile and in the ground facilities.

Radar is also used for missile tracking, especially in the first stage and the initial portion of second stage flight. Radars are of the non-search type and are initially locked on the target by optical methods. Two Navy gun-laying optical sights, one located directly behind the line of flight, the other at right angles to the line of flight, are employed to obtain initial tracking. The radar is slaved to the optical trackers and once locked on continues tracking.

Additional tracking is accomplished through a system of correlated tracking and ranging (COTAR). COTAR uses a field of antennas located X-fashion, which is near the instrumentation control center. COTAR determines the three-dimensional position of the missile and automatically presents this information to the range safety officer during the course of the missile flight.

Two operational training programs are under way at Vandenberg on the Atlas and Thor missiles. Third program, for Titan, is scheduled to commence with completion of the silo complexes. The 576th Strategic Missile Squadron, commanded by Col. J. J. Easton, recently conducted the first operational Atlas firing. Mission of the squadron, according to Easton, is two fold:

- **Operational training** for the purpose of forming a cadre of instructor personnel simultaneous with developing operational crews for future Atlas sites.
- **Emergency war** operational capability (the firing of Atlas deterrent weapons in the event of a national emergency).

The 392nd Missile Training Squaddon (Thor under Col. R. E. Barton, is

Vandenberg Funds

Atlas	$ 60,000,000
Titan	34,317,000
Thor	6,230,000
Space projects	19,230,000
Support items (Rehabilitating bldgs. Airfield construction Technical facilities)	32,700,000
Family dwellings (1,805 units)	25,560,000
Total	$178,607,000

Not included is $3,500,000 going for construction of Bomarc Facility. Of the funds allocated, $83,000,000 has already been spent or programed.

(*Continued on p. 83*)

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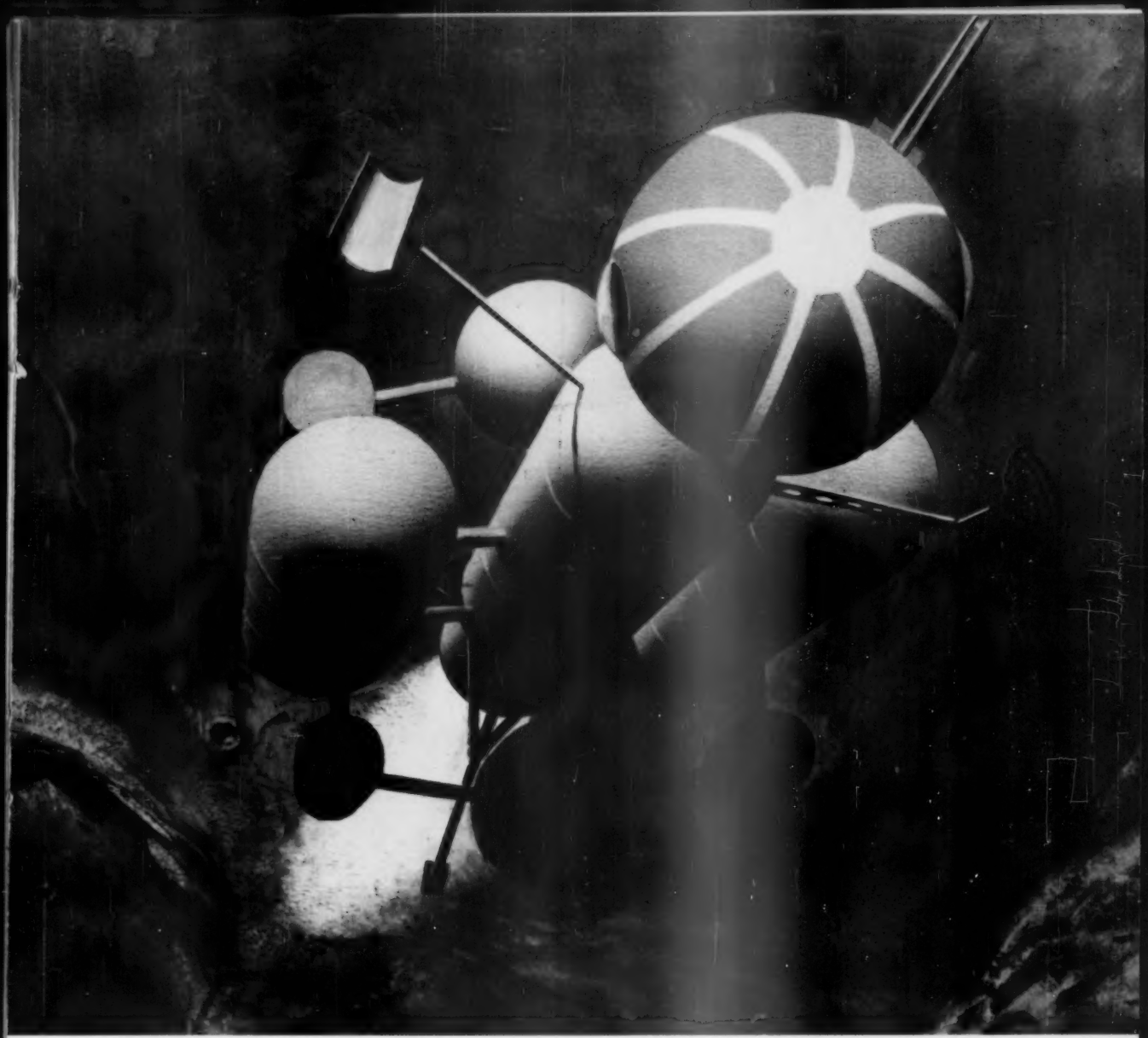

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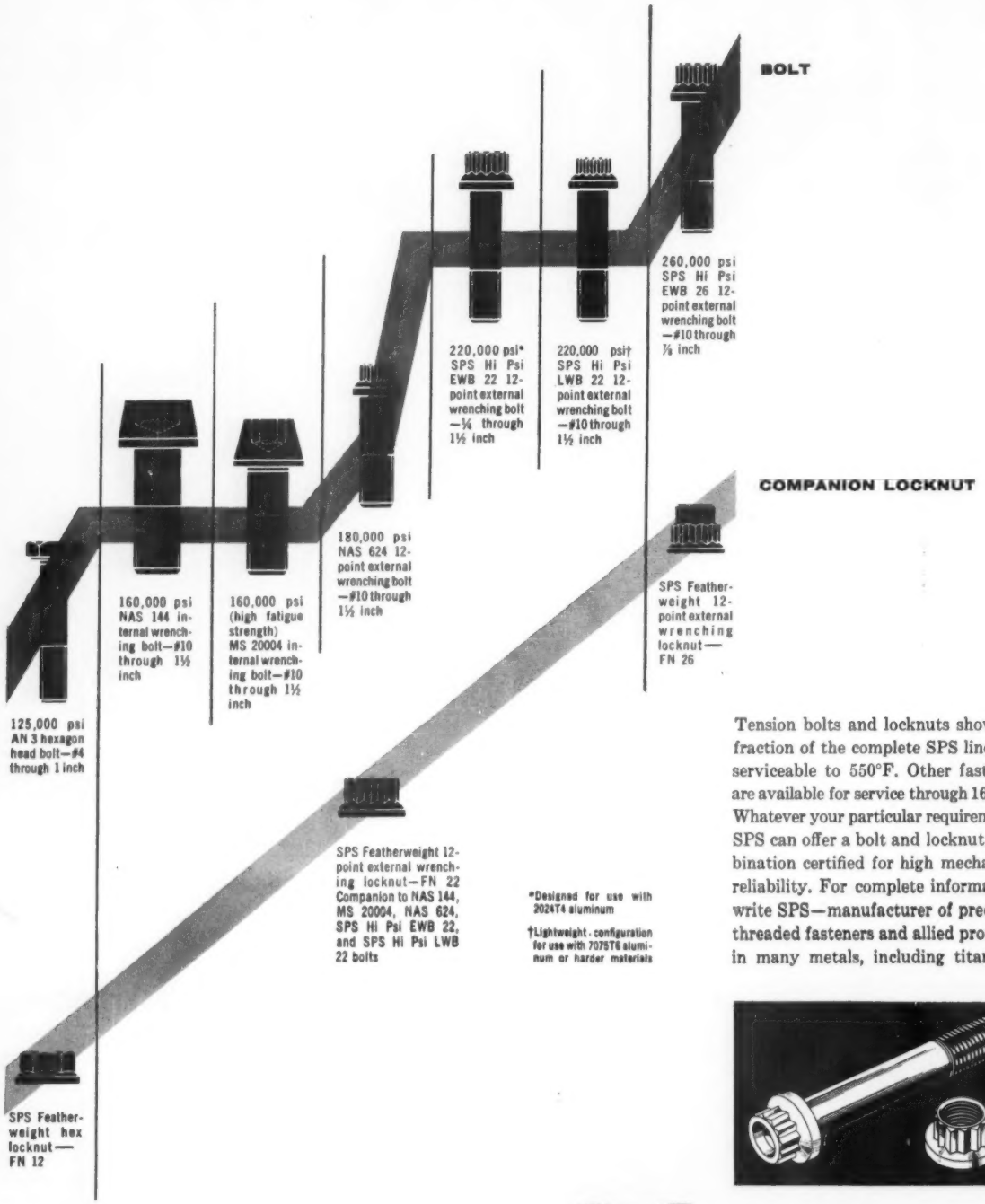
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180,000 psi NAS 624 12-point external wrenching bolt —#10 through 1½ inch
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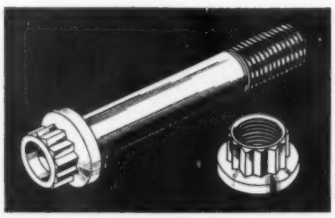

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Short Seacat Fired in Launcher Trials

Short Seacat ship-to-air missile is fired during test trials at Belfast, Northern Ireland. Missile is being projected from launcher by rocket power and is fired into bales of straw for recovery. Short Brothers & Harland says this firing technique eliminates the need for range facilities. Seacat is under development as an anti-aircraft defense weapon for Royal Navy.

training RAF crews for Thor squadrons deployed in England.

Barton's Thor squadron provides pre-operational training, or integrated weapon system training, to personnel who have first gone through individual training at with the contractor. These specialists in individual missile systems, such as hydraulics, propulsion, electronics, etc., are then "welded into a team." Barton says his program could be compared with the operational training unit method of training air crews whereby pilots, navigators, bombardiers, radio operators, etc., come from their individual schools and are given experience as an integrated crew.

Launch Crew

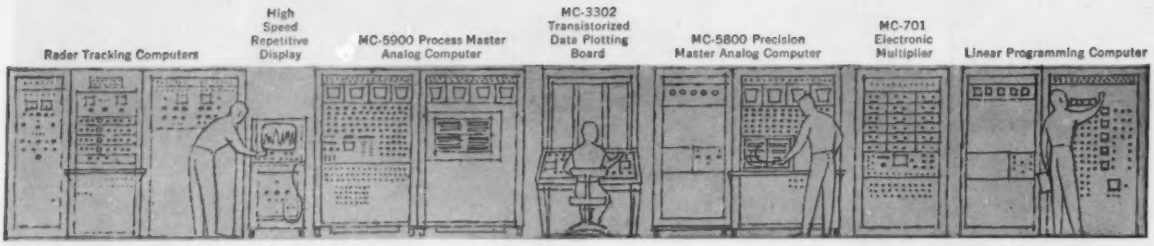
Actual launch crew for a Thor from a three-missile complex consists of one launch control officer for the entire complex, one console operator for each missile and one missile maintenance technician for each missile. The seven-man crew is the minimum required once the missiles have been placed on the pad and final checkout of components completed. During the eight-week program a launch crew goes through a total of 12 countdowns before it is considered fully trained. SAC type standardization checks are given launch crews much in the same way as standardization checks are given bomber flight crews.

Number of students in the Thor training program has varied from 150 to 300 at any one time. Once a student reports for training, each interval of his time from check-in to completion of the program is planned in advance. Altogether some 12,000 tasks must be accomplished by any one group of men proceeding through the program. Progress is kept on punched IBM cards to make sure that no portion of the program is overlooked.

Acceptance crews which receive each missile from the contractor and prepare it for launching usually go through their procedure twice during the course. Like launch crews, they also receive standardization checks. Support specialists in the various missile subsystems start their training in the re-

Malkara Anti-Tank Missile

Malkara anti-tank missile, development of Australian Department of Supply, was shown minus launcher and wire-control guidance system on the British Ministry of Supply stand at 20th SBAC display, Farnborough. Missile work was underwritten by the British and has led to adoption of the weapon as standard for the British army. The round weighs about 200 lb., has a 50-lb. warhead of conventional explosive. Powerplant is a solid-propellant rocket. Wings are movable for control about three axes; tail surfaces are fixed. Guidance is by trailing-wire system and effective range is estimated at approximately two miles. System is being produced by National Instrument Co. Pty., Ltd. of Australia. More than two dozen test firings have been made at the weapons range at Kircudbright, Scotland. Development batch of 150 Malkara missiles was bought last year for evaluation by British.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ceipt, inspection, maintenance building referred to as the RIM building. Actual preparation of the missile takes a crew of eight men, although not all eight are needed simultaneously.

Once the missile has finished in the RIM building, it is transported to the launch pad where the second phase known as indexing is accomplished. Here components of the missile are assembled and properly mated. Third stage of the training is the preparation for launch during which the missile is erected and external power applied.

Fourth Phase

Fourth phase is the launch stage, referred to as the T-minus-15 period. During this stage the missile is held on 15 min. alert and the crew, during its standardization check, can expect to launch on a no-notice basis. During this latter phase, crews will undertake single propellant and double propellant flow during which either one or both of the RP-1 and liquid oxygen propellants will be transferred to the missile's tanks.

Thor training will be continuous since it is planned for crews to return to Vandenberg twice yearly for refresher training and up-dating, referred to as Combat Crew Training Launch program.

Atlas training course is 12 weeks in duration, compared with eight weeks for Thor. Like the Thor program, students in the Atlas training program come to Vandenberg from individual training with contractors at the manufacturing facilities. To a great extent, Col. Easton credits the Thor program with providing a good deal of help in formulating his program. Personnel strength of the 576th is a little more than 700. One of the prime differences in the new programs is the dual role of the Atlas training, whereby the Emergency War Operation capability is being developed in parallel with the operational training program. No similar parallel exists in the Thor program because of the obvious lack of operational ability from Vandenberg for the Thor weapon.

Atlas Training

Atlas training is of a more intensive type than that for Thor, primarily because of the greater complexity of the missile itself. A launch crew consists of 13 men for the vertical type launcher and 12 men for the horizontal, or semi-hardened, installation. Easton says that with each succeeding model of Atlas, personnel rejuirements become less due to a decrease in complexity of the guidance system, fueling system and other components. One of the biggest problems in Atlas is that of quality control inspection, because the systems in

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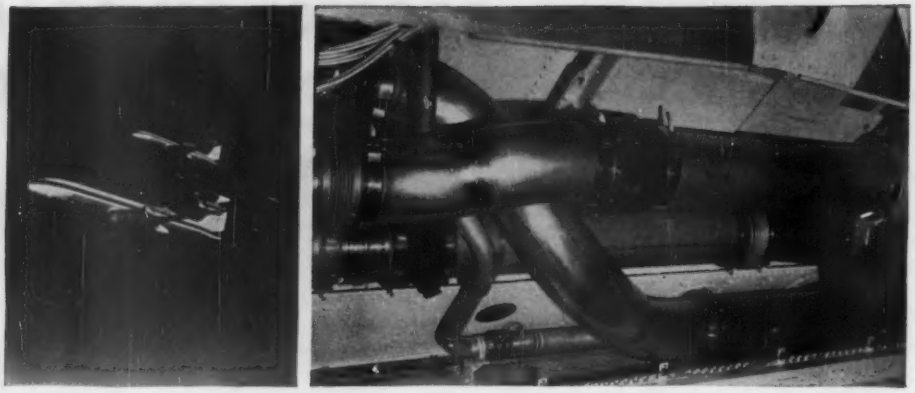

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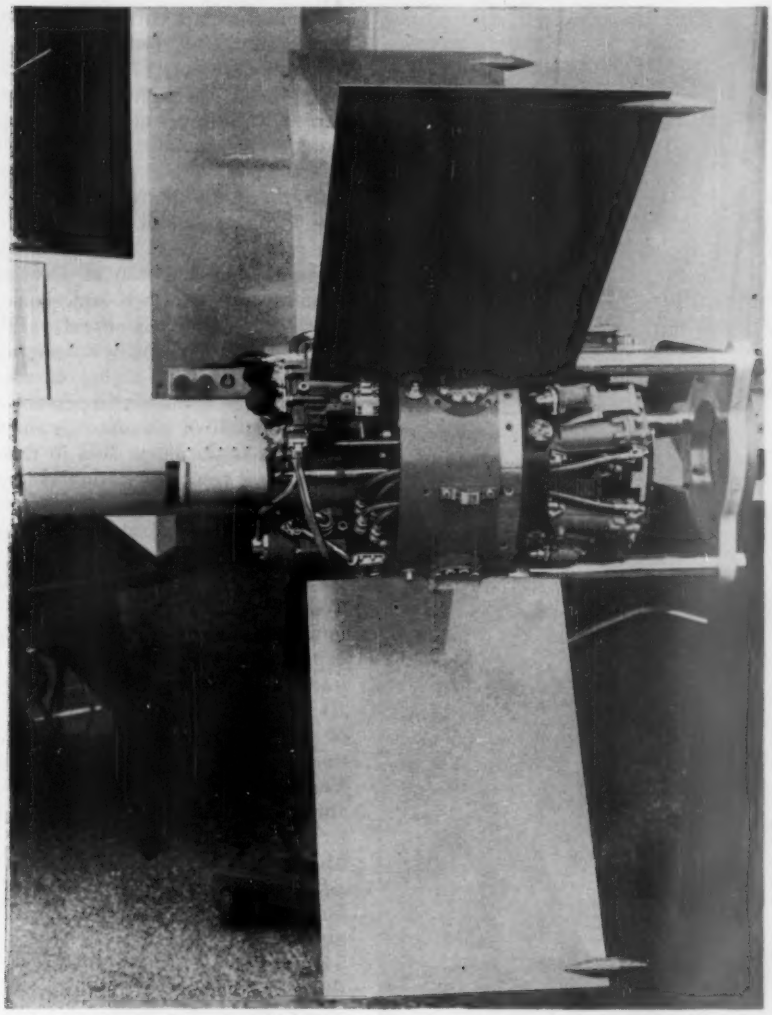
the missile are not redundant as in aircraft. Easton expects a further reduction in personnel with the introduction of all-inertial guidance in Atlas.

The SAC 16-hr. day is much in evidence in the 576th Strategic Missile Squadron since the world situation has caused an acceleration in and a time compression of the training program schedule.

In addition to the regular squadron duties of training and preparing for the Emergency War Operation capability, personnel are attending night courses in management, considered one of the most important aspects of making Atlas a truly operational strategic weapon.

One area which Col. Easton says leaves large room for improvement is the ground support equipment necessary for Atlas. "We are now in the Model-T stage of missiles," the colonel said, "and simplification will come by a natural progression of the state of the art."



Movable Tail Surfaces Control Seaslug

Control ring and movable tail surfaces of Armstrong Whitworth Seaslug, surface-to-air missile under development for Britain's Royal Navy, shows details of control system for the weapon. Basic internal power for system comes from isopropyl nitrate gas generator driving an alternator and a hydraulic pump. Servos are electromechanical units, can be seen at right of control surfaces. System is basically an autopilot type which roll-stabilizes the missile after the boost phase, in which the missile is deliberately rolled to reduce dispersion and make beam capture easier. System also limits accelerations on missile airframe and maintains performance through variations in speed and altitude. Seaslug has solid-propellant sustainer and four solid-propellant wrap-around booster motors. Guidance is beam-rider type. Seaslugs will be part of the armament of Royal Navy guided missile ships HMS Hampshire, Devonshire, Kent and London. Missile will be fired from a single twin-round launcher on ship's afterdeck.

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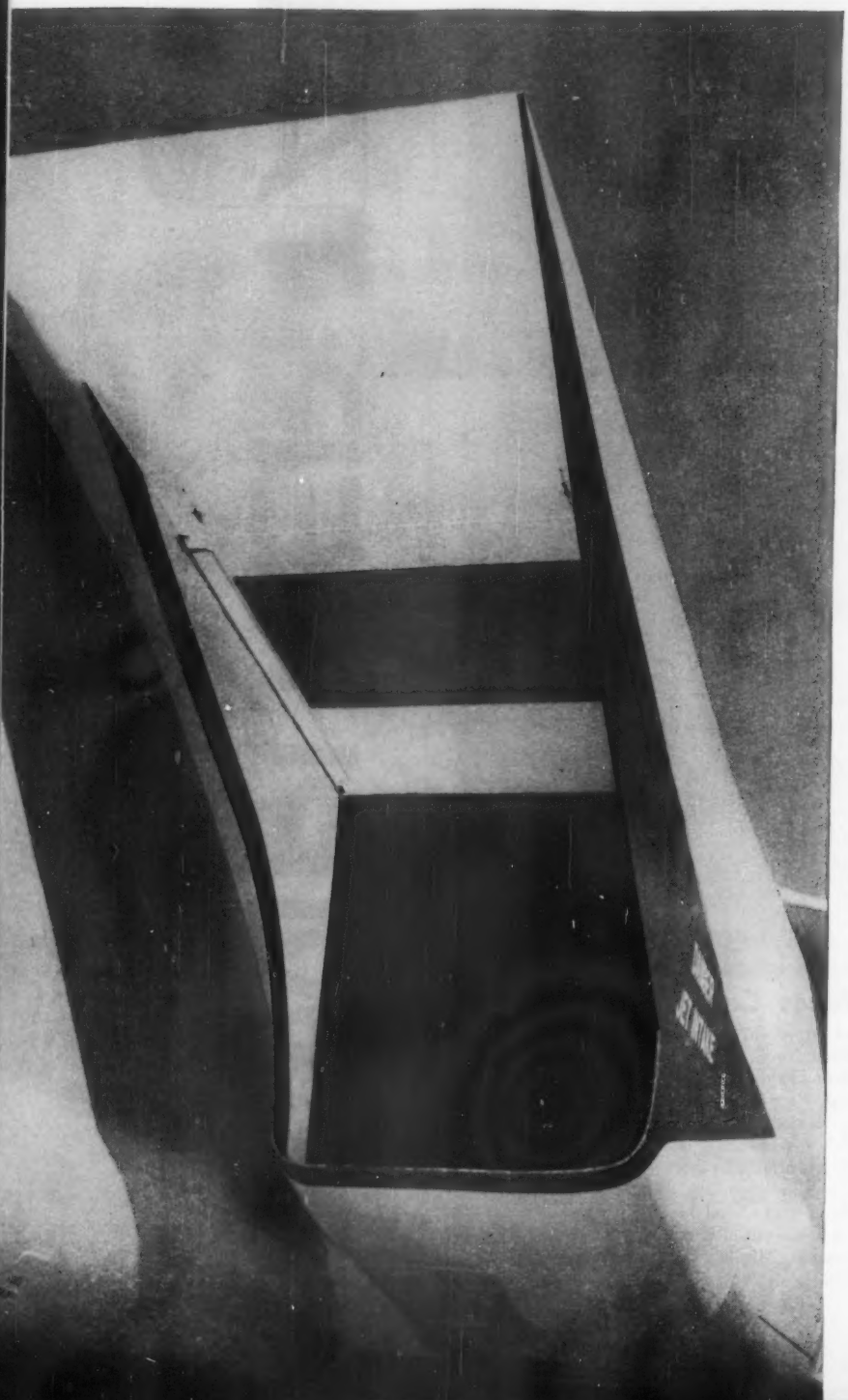
Corrosion-Fighting Titanium Sheet Paves Way for Honeycomb in Navy A3J



Titanium metal's corrosion resistance has enabled North American Aviation designers to draw upon the stiffness and light weight inherent in honeycomb-core construction for the inlet guide ramps of the Navy's Mach 2 attack aircraft, the A3J Vigilante.

• Titanium metal, immune to salt water corrosion build-up, has proved so effective in replacing aluminum cover sheets and channels that existing A3J aircraft will be retrofitted with the new design. The overall weight saving—in effect a design bonus—is 22 percent.

Installation of titanium in this assembly is the latest step in the continuing trend of designers to capitalize on titanium's unique combination of intrinsic properties: low density (0.16 lb./cu. in.), great strengths, outstanding corrosion resistance, and ability to retain its properties under long-time exposure from —300° F up through intermediate temperature ranges. Its effectiveness under conditions of short-time exposure was seen in its use as the nose-cone tip of the Vanguard where titanium withstood temperatures of 1500°F.

The A3J inlet ramps are made of flat, tapered titanium sheets adhesive-bonded to an aluminum honeycomb core. Each assembly is about 5 ft. long, 2 ft. wide, and 3 in. thick, with 16,000 holes drilled through the skin, to control air flow to the engine. Because a large volume of air flows through these holes, a small amount of corrosive product build-up would seriously impair the ramp's performance.

An integral part of the panel is an I-beam-shaped titanium alloy rib which connects the ramp to its actuator. This rib, machined by North American from a Ti-6A1-4V

heat-treated forging, weighs about 6 lb., and is riveted into the panel.

To take advantage of the corrosion resistance properties of titanium in this application, North American worked out two machining operations and an adhesive bonding technique.

MILLING THE FACE PLATES: The titanium face plates are tapered, from 0.090 in. thick at one end to 0.045 in. at the other. This taper is achieved by milling the sheet, in one pass, with HSS cutters. During the operation, the work is completely submerged in a solution of one part denatured alcohol and three parts water. Cutting speed is 180 rpm, with feed rates from 5 to 20 ipm.

ADHESIVE BONDING: The tapered skin is bonded to the honeycomb core with Bloomingdale Rubber Company's HT-424 adhesive. A four-step preparation was developed for this operation: vapor degrease, acid pickle (25-35% HNO_3 plus 2-4% HF), application of fluoride phosphate coating, and hot water rinse.

DRILLING 16,000 HOLES: After the skin is bonded to the honeycomb core, 16,000 holes 0.050 to 0.060 in. diameter are multi-spindle drilled through the skin, in a milling machine setup with a 130-spindle gearless drillhead. The HSS drills have short shanks, to minimize wear and breakage. Cutting fluid is a soluble-oil emulsion.

North American's use of titanium primarily for corrosion resistance highlights one of the properties of titanium metal attractive in construction of:

- **ENGINES: Titanium metal eliminates the possibility of stress-corrosion or salt-water-spray pitting with its consequent fatigue damage of compressor, turbine blades and other engine parts. This is of unusual importance to commercial carriers who expect their new jets to operate 8 to 10 trouble-free hours daily. Weight advantages can provide significant economies in fuel savings alone, during seven years of operation.**
- **MISSILES: Titanium metal provides excellent resistance to the corrosive effects of rocket fuels such as liquid fluorine and ammonium perchlorate, at the same time providing minimum weight structure and outstanding cryogenic properties.**

Price reductions in titanium metal and mounting experience in working with titanium have enabled fabricators to produce assemblies with competitive advantages that more than outweigh materials cost differentials.

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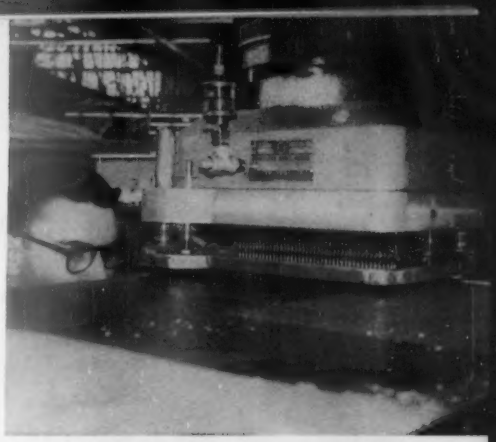

MULTI-SPINDLE DRILLHEAD mounted in milling machine makes 130 holes per pass. Surface has 16,000 holes 0.050 to 0.060 in. in diameter. Former parts were made of aluminum, which corroded and interfered with proper air flow

HONEYCOMB CORE MATERIAL is being adhesive-bonded to titanium spar (machined from Ti-6A1-4V forging), and will subsequently be bonded to tapered titanium sheet. Total weight saving of 22% is a bonus to the manufacturer. Titanium was chosen for its corrosion resistance

ULTRASONIC PROBE TESTS for completeness of bond between core and skin. Bracket at center of ramp assembly is part of a Ti-6A1-4V titanium rib, machined at North American from a Wyman-Gordon Company forging. Bracket is connected to actuator, to control pitch of inlet guide ramp

Sikorsky S-60 —opens a new world of helicopter usefulness

PRIME MOVER—The Sikorsky S-60 crane helicopter, with a five-ton payload, is the prototype of a new family of UTVs (Universal Transport Vehicles) of almost unlimited usefulness. It is an aerial prime mover, an airborne cousin to such ground prime movers as locomotives and truck trailers.

INCREASED MOBILITY—Independent of roads, tracks and all surface obstacles, flying cranes will move passengers and cargoes with unprecedented speed and agility. New techniques, using hoists, platforms, bins and pods, will greatly reduce loading and unloading times.
(Above, the dump truck technique makes possible quick unloading of transported fuel drums.)

SMOOTH FLIGHT—Loads suspended under the S-60 fuselage are virtually free of vibration—a major advantage in carrying big passenger pods or in transporting sensitive cargoes such as missiles.

NEW POWER—Sikorsky crane helicopters now in design will have high-powered gas turbine engines and will carry payloads from eight to 40 tons.

SIKORSKY AIRCRAFT, Stratford, Connecticut
A division of United Aircraft Corporation

Grand Central Adding To Research Facilities

Redlands, Calif.—Expansion of facilities and initiation of a propellant research program has been activated by Grand Central Rocket Co. here. Principal facilities to be constructed include a propellant research laboratory and engineering and administration buildings.

Board Chairman Maj. Gen. John W. Sessums, Jr., (USAF, ret.) said the program is necessitated by the continued demands of the Nike Zeus anti-missile missile program, but declared that the expansion is a part of a continuing development program in which emphasis will be placed on research and development.

Twelve new installations in the master facility plan will be given top priority because of their importance to Nike Zeus.

These include the following:

- **High accuracy** digital instrumentation facility.
- **Non-destructive test** facility for X-ray, ultrasonic test and magnetic particle inspection.
- **Electrical system** modernization at both the Redlands and Beaumont, Calif., plants.
- **New in-plant** water systems.
- **Quality control** laboratory.
- **Experimental machine** shop.
- **Rocket motor** storage building.
- **Rocket motor processing** building and other lesser installations.

More than $2 million will be spent in propellant research to prove and develop a new class of high-performance propellants which might possibly be ready within a year, according to Dr. Cledo Brunetti, vice president and general manager.

Grand Central, an affiliate of Food Machinery and Chemical Corp. and Tennessee Gas Transmission Co., presently has a production capacity of 750,000 lb. of propellant per month.

Aerojet, Thiokol Develop Rocket Packs

Personal rocket packs now under development may become standard field gear for troops, provided U. S. Army can obtain necessary funds. Devices are designed to help soldiers in hurdling unusually high obstacles or in crossing difficult terrain. Unit at left is mockup of Aerojet-General's free-flight Aeropak. It consists of a U-shaped fuel tank, pressurized air tank and two thrust chambers. Fuel is hydrogen peroxide which is decomposed into steam and oxygen by a silver catalyst. Decomposition products are ejected through two exhaust nozzles to provide variable thrust up to 150 lb. Unit at right is a model of Thiokol's Jump Belt, originated by company's Reaction Motors Division. It consists of several replaceable cans of solid propellant affixed to a manifold which exhausts the combustion products through a nozzle on each side of the soldier. Belt will weigh approximately 20 lb. As in the Aeropak, thrust will be variable and at the control of the wearer.

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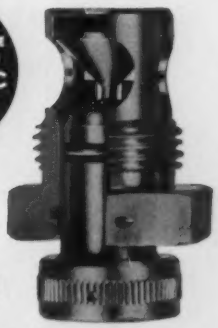

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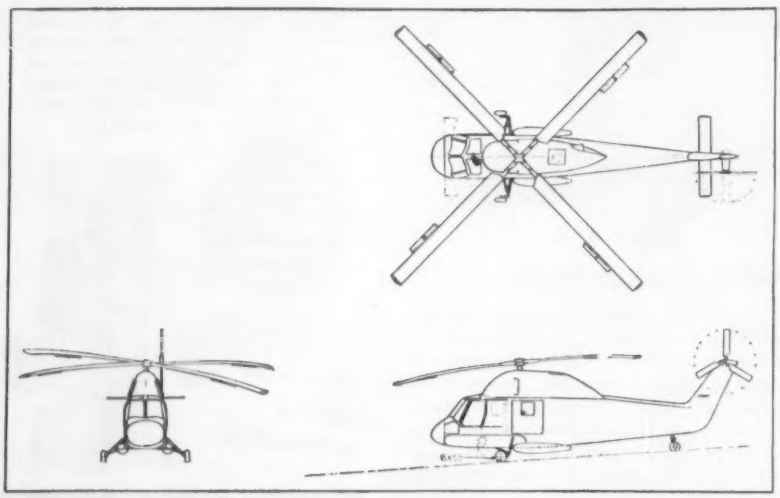
Kaman Goes to Single Rotor for HU2K-1

By William F. Burke

ROTORS, self-supported by locking pitch axes, fold back in 60 sec. One-piece nose bubble contains avionics, will be replaced by clamshell doors on production models.



EARLY THREE-VIEW shows 58-gal. auxiliary tanks in place. Two-piece servo flaps shown in diagram have been replaced by a one-piece version as a result of flutter tests.

Bloomfield, Conn.—Single-rotor design of the turbine-powered HU2K-1, chosen for high speed and long range, marks a major break in Kaman Aircraft Corp.'s long-standing intermeshing rotor design tradition.

Navy Bureau of Aeronautics had already committed $27 million to the HU2K-1 program before the first aircraft flew here late in June (AW July 6, p. 27).

The first two prototypes have rolled off Kaman's assembly lines here under an initial $13 million contract (AW Jan. 20, 1958, p. 79) for delivery of four aircraft this year. Kaman has a $14 million follow-on order (AW Feb. 23, p. 35) and will deliver the first production HU2K in January, with 11 more to follow at monthly intervals next year.

The last two aircraft in the original order for four are on schedule for rollout this month and in December.

Search and rescue is the HU2K's primary mission, along with utility and long-range high-speed liaison duty with the fleet. Original Navy specifications, outlined in a design competition in 1956, had called for performance exceeding any then-existing helicopter, with high speed a priority for cold water rescues.

Fleet Tests

Actual Navy requirements for the aircraft will depend on the success of fleet tests scheduled for 1961. However, 250 to 300 HU2Ks might be placed in fleet service if the aircraft meets Navy expectations, according to Rear Adm. Charles T. Booth, Assistant Chief of Bureau of Aeronautics for plans and programs. The HU2K-1 was tentatively conceived as a replacement for all Navy search and rescue craft, he added.

Navy would apportion two per carrier, one per cruiser, and one on miscellaneous vessels such as destroyers with landing pads. Aside from routine utility missions, the HU2K can carry 13 combat troops in bucket seats, or accommodate up to four litters.

An anti-submarine role is out of sight for the HU2K at present, Adm. Booth said. Unlike the Navy-sponsored Sikorsky HSS-2 (AW Mar. 30, p. 30) the smaller, single-turbine HU2K lacks the payload capacity to carry attack weapons in addition to detection gear.

However, a possible ASW role could develop out of a Royal Canadian Navy interest in the aircraft because of its

ability to operate off the many small vessels in the Canadian fleet as well as its automatic stabilization equipment for precise hover control during sonar dunks (AW Sept. 28, p. 23).

A virtually all-new helicopter, the HU2K embodies few components from previous Kaman aircraft. Key design features are: all-aluminum construction, aluminum and glass fiber rotors, fully retractable landing gear, flotation hull, maintenance provisions and a sophisticated avionics system designed for in-flight operating simplicity.

The virtually all-aluminum fuselage is of semi-monocoque design with a tub type flotation hull. Chief structural member is a built-up, beaded-aluminum sheet centerline keel running aft to the pylon extension, separating the cabin deck from the belly to form a two-foot-deep flotation chamber that also houses main fuel tanks.

Structural Framing

Normal structural framing is hot-formed 75ST aluminum. At primary frames (engine, transmission and landing gear supports) construction is of extruded flanged 75ST sheet web. The only departure from the use of 24ST stressed skin throughout is the soft annealed titanium sheet beneath the turbine to reduce fire hazards.

A two-cell, 100-gal. front tank straddles the keel within the flotation chamber on line with the ship's center of gravity just aft of the cockpit. A 176-gal. two-cell rear tank is mounted just below the left-side cargo door. Cells are synthetic rubber impregnated nylon and interconnect through the keel. Two 58-gal. inflatable auxiliaries can be slung on both sides of the belly for extended-range missions and roll up for stowing when not in use.

A standard single-point pressure fueling-defueling outlet is provided, although all tanks have external gravity-fill caps. The forward tank serves as a sump, all fuel being transferred to the engine through it. Other tanks are valved to empty into the sump tank selectively (auxiliaries first, then rear) to hold center of gravity travel to a minimum. Fuel is JP-4 or JP-5.

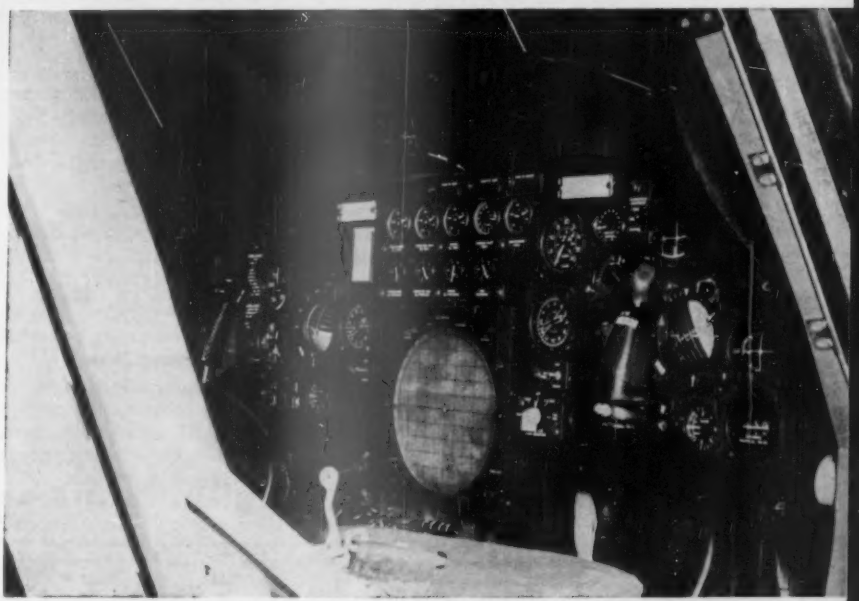
Powerplant is a single 267-lb. General Electric T58-GE-6 free turbine engine (AW Dec. 16, 1957, p. 69) rated at 1,025 nominal shp. maximum power and 875 shp. for maximum speed continuous operation. Growth capacity has been provided for the more powerful 1,250-hp. T58-GE-8 when it is available.

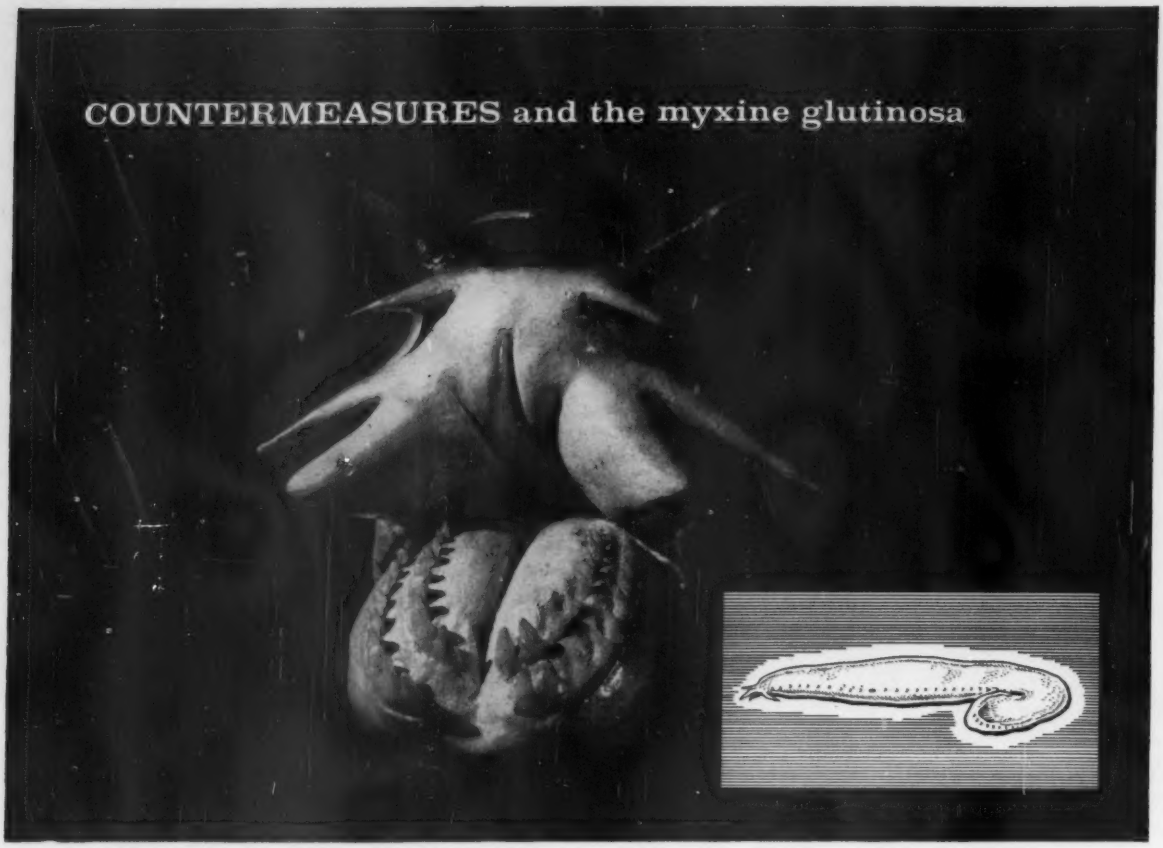
Compressor bleed air is ducted away for cabin heat. The exhaust stack is positioned so exhaust gases will wash over the tail rotor for deicing.

A T58 accessory gearbox is mounted on the rear of the engine. It provides a single stage 3.25:1 reduction in lower-

CLEAN LINES are evident in this gear-up photo. Horizontal stabilizer is required for high-speed stability. Protrusion from belly amidships is a UHF antenna.

RESCUE HOIST will swing out through door just forward of starboard engine intake, above. Mockup of panel layout, below, is dominated by pilot's dead-reckoning indicator.





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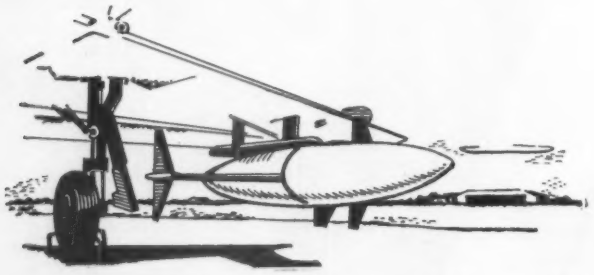
Seventeen inches of devastating destruction are represented in the pictures above. Appearing to be no more than another small eel, this specimen can, in a matter of hours, eat his way through the skin of his victim and then proceed to devour everything except bone. Things are not always what they appear...a theme common to countermeasures .

Certain types of countermeasures under development also might be said to have hidden teeth.

A small drone, equipped with devices to make it appear as one or more bombers when viewed on radar scopes, could very well carry an atomic warhead capable of delivering a devastating blow to a secondary target. Instruments For Industry has for many years been actively engaged in the development and perfection of many types of countermeasures for the Army, Navy, Marines and Air Force. All have reaped the fruits of I.F.I.'s specialized engineering know-how.



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HU2K-1 Specifications

Empty weight	5,052 lb.
Maximum gross weight	9,152 lb.
Fuel capacity	
Main tanks	276 gal.
Auxiliary tanks	116 gal.
Main rotor diameter	44 ft.
Tail rotor diameter	8 ft.
Length over-all	52 ft. 2 in.
Height over-all	14 ft. 8 in.
Landing gear tread	10 ft. 10 in.
Powerplant: One General Electric T58-GE-6 free turbine rated @ 1,050 shp.	

ing shaft speed to about 6,000 rpm. and drains about 26 hp. An idler gear separates the two spur gears in the rear box to clear the shaft for its forward travel to the rotor transmission.

The engine is supported at three points: a static mount at the bottom of the rear gearbox takes out vertical and horizontal loads, a ball joint on the left side of the gearbox takes out torsional loads, and a pivoted mount at the right front compressor stage takes out vertical and lateral loads. All mounts are forged aluminum and attach to sheet aluminum brackets that spread forces over several heavy frames.

Magnesium Transmission

The HU2K's cast magnesium transmission, weighing about 560 lb., sits on four tubular aluminum V-frames that are canted forward and also left to allow wheels-level hover. Planetary gearing reduces shaft speed from about 6,000 rpm. to normal levels (241 rpm. for hover, 278 rpm. for high-speed cruise). A hydraulic pump is driven off the rotor hub instead of from the engine, therefore hydraulic pressure is available only when the rotor is turning.

A steel gear-joint shaft runs along the ship's backbone to drive the tail rotor. Access doors open to either side for the full shaft length.

A pylon-mounted horizontal stabilizer, actuated by a full-span servo tab, is interconnected with the pilot's cyclic stick. Stabilizer is intended for high-speed stability (speeds over 100 mph.), Owen F. Polleys, HU2K project engineer, told AVIATION WEEK.

The HU2K is not an amphibian; flotation was designed only for emergencies (i.e., over-water engine out landings). Flotation chamber is only semi-watertight, but would permit the aircraft to float for approximately one hour or more, Kaman engineers said. Inflatable sponsons, which pop out forward of the landing gear fairing, give lateral stability in the water but are not needed for buoyancy. In the water the HU2K will stabilize to a 30-deg. turnover angle. Inflation is by solid propellant firing through an ammonia cooling agent to fill both 57 cu. ft. bags in 2½ sec. with 30F gas.

Primary function of the HU2K's fully retractable landing gear is to avoid cable tangle in rescue missions, although the retractable gear also cleans up the aircraft for high-speed flight. Since the gear is a lever suspension type the wheels do not protrude after retraction into wells. The gear has a fast retraction time of 2 sec.

Gear construction consists of a high-strength forged 79ST aluminum bipod main member, with a steel drag strut ahead which breaks in the middle to fold the gear forward. Liquid oleo springs are used.

Gear Control

A standard wheel-shaped gear actuation handle is located next to the pilot's collective stick so he can drop gear and collective in one motion in an autorotation landing. Manual gear operation is not provided, but the pilot can gravity-drop the gear by venting the hydraulic system with a separate lever, which also releases the up-lock catch.

The gear mounts a low aspect ratio tire, developed especially for the HU2K, which is constructed to resist sideways flexing.

The helicopter's 44-ft. diameter aluminum and glass fiber rotor blades can be folded back in the horizontal plane within one minute of engine shutdown in winds up to 60 mph.

Rotors mount the traditional Kaman servo flaps which eliminate the need for a hydraulic boost control system. Main member of each individually interchangeable blade is an extruded aluminum D-section spar with 17 glass fiber segments measuring about 12 x 12 in. attached to form the trailing edge.

Kaman broaches out the aluminum spars to eliminate internal grinding and to extend fatigue life with a good internal finish. Broaching is a 39-pass operation through the 23½-ft. aluminum spars, which are later cut to their usual 18½-ft. length. Broaching also cuts rotor weight about 5%.

After broaching, the spars are rough machined on a two-dimensional template miller, then hand ground and twisted to final dimensions. A deicer boot is fitted over the spar capped by a 0.005-in. stainless steel leading edge on the exterior.

Rescue Equipment

Designers provided a right-hand rescue door large enough to admit a survivor tied to a one-man life raft. The rescue cable passes down the right side directly in the pilot's line of sight. The 600-lb. capacity hydraulic hoist swings outboard through doors in the transmission housing above and slightly behind the pilot's head. The hoist can be operated by a crewman in the rescue

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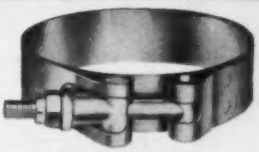

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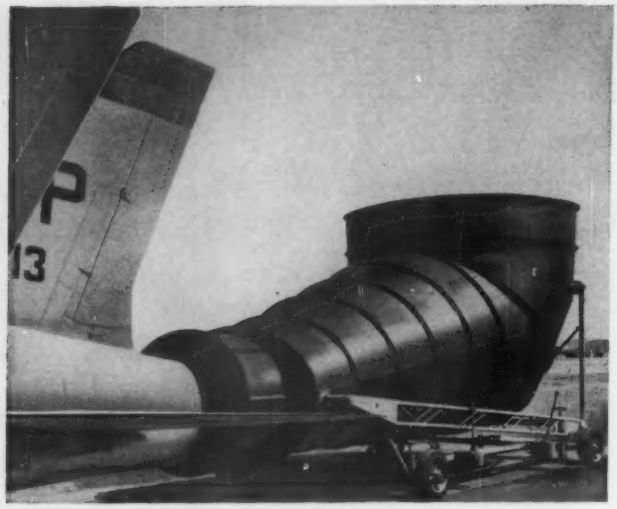

Maxim JEM-8 Silencer on run-up duty on F8U.

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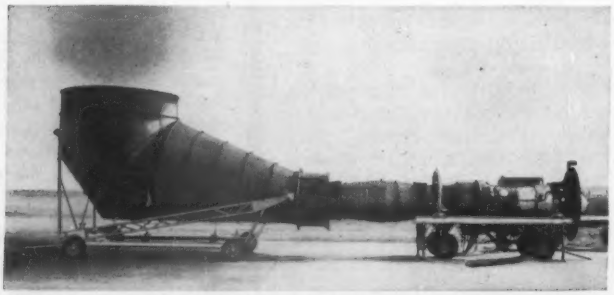
Built for high temperatures, the JEM-8 is a portable, all-metal spoiler type unit with a maximum weight of 10,000 lbs. including undercarriage. Engineered for all present types of jet aircraft, it is available with adapters for various airframe configurations.

Shown here in use at a naval air station, the JEM-8 will shortly be on duty at many other Naval and Marine Corps air stations. A commercial jet version, the JEC-8, is available for pod hung engines.

For noise suppression, consult Maxim — for it is here that Silence Is A Science.



JEM-8 with undercarriage raised for test stand.

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door, or by an override button on the pilot's cyclic stick.

A floodlight aft on the pilot's side lights the rescue area. The pilot also has a 450-watt searchlight that he can extend and rotate during night search.

Kaman developed its own automatic stabilization equipment (ASE) and dead reckoning navigation equipment for the HU2K to provide maximum flexibility in rescue work, all-weather flight and ASW. When coupled, the ASE and autonavigator provide complete, hands-off control.

Flight Modes

With ASE, the pilot has three distinct flight modes at his command, including:

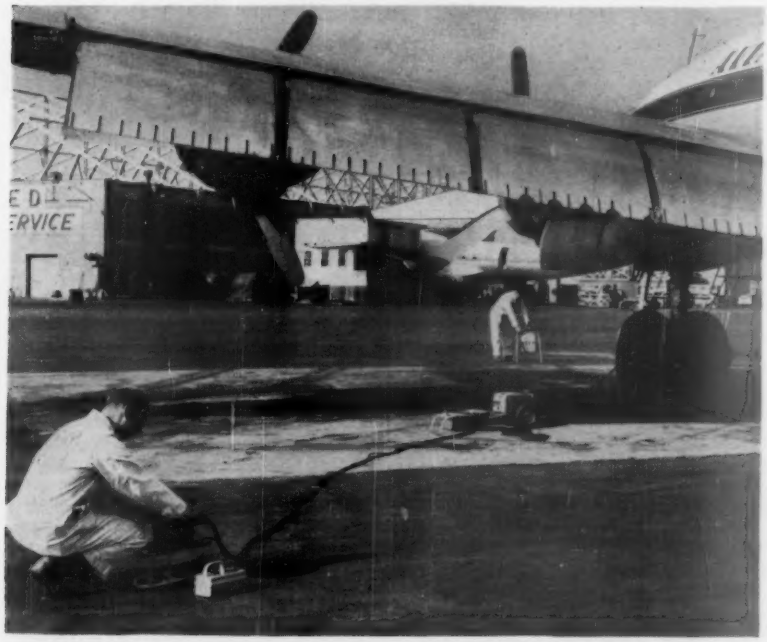
- **Mode 1:** Conventional manual flight, with or without hydraulic boost as the pilot desires.
- **Mode 2:** A limited authority ASE mode which stabilizes for slight variations about the pilot's stick commands. The pilot would select this mode in normal flight to avoid making constant trim changes, etc. Stops in the system make it impossible for Mode 2 ASE to stabilize the aircraft during extreme attitude changes, for example in a strong gust, in which case the pilot would have to correct manually.
- **Mode 3:** A fully automatic flight mode in which ASE and autonavigator are coupled to provide all advantages of Mode 2 operation, plus 100% authority stabilization control, plus controlled ground or airspeed as desired, plus controlled pressure or radar altitude as desired.

The ASE system is simple in conception, although complex in detail. Chief components are a gyro and accelerometer sensing system, hydraulic control link actuators (one each for lateral pitch, longitudinal pitch, collective pitch and rudder), and bungee actuators to make trim and control stick changes.

The four hydraulic control link actuators are the heart of the system in Mode 2 flight. Hydraulic actuators receive signals from the gyro group and make slight changes in the control links themselves, without moving the rudder or cyclic stick. Actuators contain stops, and are therefore designed to return to a mid or null position when not making control movements so that full control limits are always available.

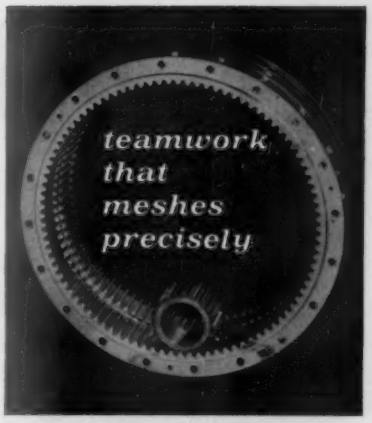
If a short-term adjustment is needed to retrim the aircraft (such as during a light gust or when a crew member moves about in the rear compartment), the actuators would make the necessary adjustment, then return to their original null position.

For long-term changes (such as a permanent center of gravity shift due to fuel transfer or reseating of passengers) the actuators would first make the necessary corrections, then because they could not return to null (maximum



Lockheed Inspects Landing Gear With Iridium 192

Iridium 192, a source of metal-penetrating rays similar to X-rays, is used by Lockheed Aircraft Service, Inc., at New York International Airport to inspect the landing gear of a Super Constellation. Technician in foreground is operating a remote control system which transports the Iridium 192 from its portable lead safe (center) to a lead gun near upper part of landing gear. Use of system is authorized by Atomic Energy Commission.



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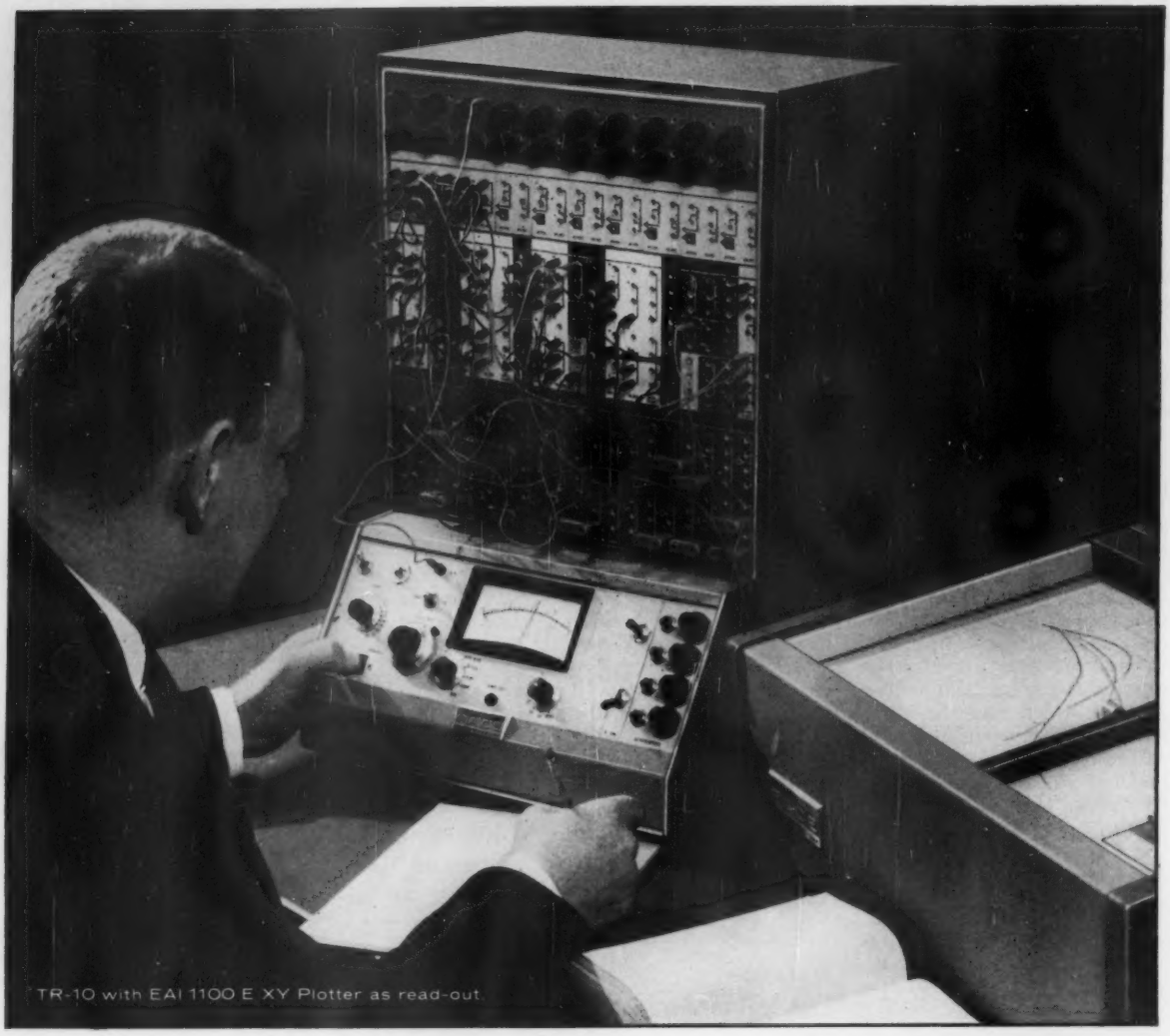

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For complete engineering data, write for Bulletin TR-10-A.

EAI ELECTRONIC ASSOCIATES, INC.
Long Branch, New Jersey

control limit) position without altering the HU2K's attitude, they would feed back to the control stick trim actuators which would retrim the aircraft for the new weight distribution.

The pilot simply sets up Mode 2 with two switches, hydraulic boost and ASE engage, on the center console. He then flies as usual with ASE stabilizing around any trim he sets into his controls. Permanent changes are made by retrimming the aircraft.

Coordinated turns are provided by a rate gyro, which kicks out of the system when the aircraft nears hover speeds so that it can be slipped into the wind for fixed position hover.

Hands-Off Flight

In Mode 3 the control trim actuators come into full play, moving the pilot's flight controls to stabilize the aircraft during any attitude change the pilot could correct for manually, allowing hands-off flying. Mode 3 also ties into the automatic navigation system to control speed and altitude.

The pilot engages Mode 3 by turning on the navigation computer and actuating radar or pressure altitude switches, and ground or airspeed switches. As before, the pilot picks up any new heading, altitude, rate of climb, etc., by merely retrimming as in manual flight. An ASE defeat switch is located on the cyclic stick.

Kaman's automatic dead reckoning navigation system (ADRN) which ties in with ASE in Mode 3 flight, consists of an analog dead reckoning computer that accepts inputs of magnetic heading and, alternatively, ground or airspeed, and continuously computes the aircraft's position.

The navigation solution is displayed on a pilot's dead reckoning indicator (PDRI) centered on the instrument panel. The PDRI does not display position on a chart background, but does give relative position using grid lines as cardinal directions. A spot of light shows aircraft location.

Typical Mission

On a typical mission, for instance a 75-mi. flight from a cruiser to a search area with a 10-mi. sector to be searched, the pilot could select the groundspeed computer input, sketch his course and search area on the PDRI grid, then cover an accurate ground track throughout the mission by flying the spot and the line.

The HU2K cockpit is roomy and well instrumented, with conventional dual flight presentations flanking centered engine instruments.

In addition to standard instruments, the flight group includes a radar altimeter, Tacan course and range indicator, and a combination groundspeed-drift angle indicator. PDRI screen, approximately 10 in. in diameter, is centered below the engine instruments.

Center console contains ADRN controls, ASE coupled functions, IFF, doppler radar controls and communications.

Communications group includes a 1,750-channel UHF transceiver, a 10-channel middle high frequency transceiver (operating approximately in the LF band) for long range, low altitude communications (approximately 125 mi. range at sea level), LF ADF, UHF ADF and Tacan. Overhead panel contains standard emergency panel, switches, circuit breakers, etc.

Virtually all electronics are housed on shelves within glass fiber clamshell doors in the nose, except for a doppler radar located in the belly about two-thirds of the way aft. Doppler package, weighing about 70 lb., was placed in the rear to avoid running high voltage wiring through the passenger compartment.

The HU2K electrical system has 100% reserve power. The system is a.c., driven by a 20 kva., three-phase, 400-cycle 115/200-v. generator. A standby a.c. generator serves de-icers and also acts as a reserve. Direct current power for avionics is supplied by a transformer rectifier.

Maintenance features of the HU2K

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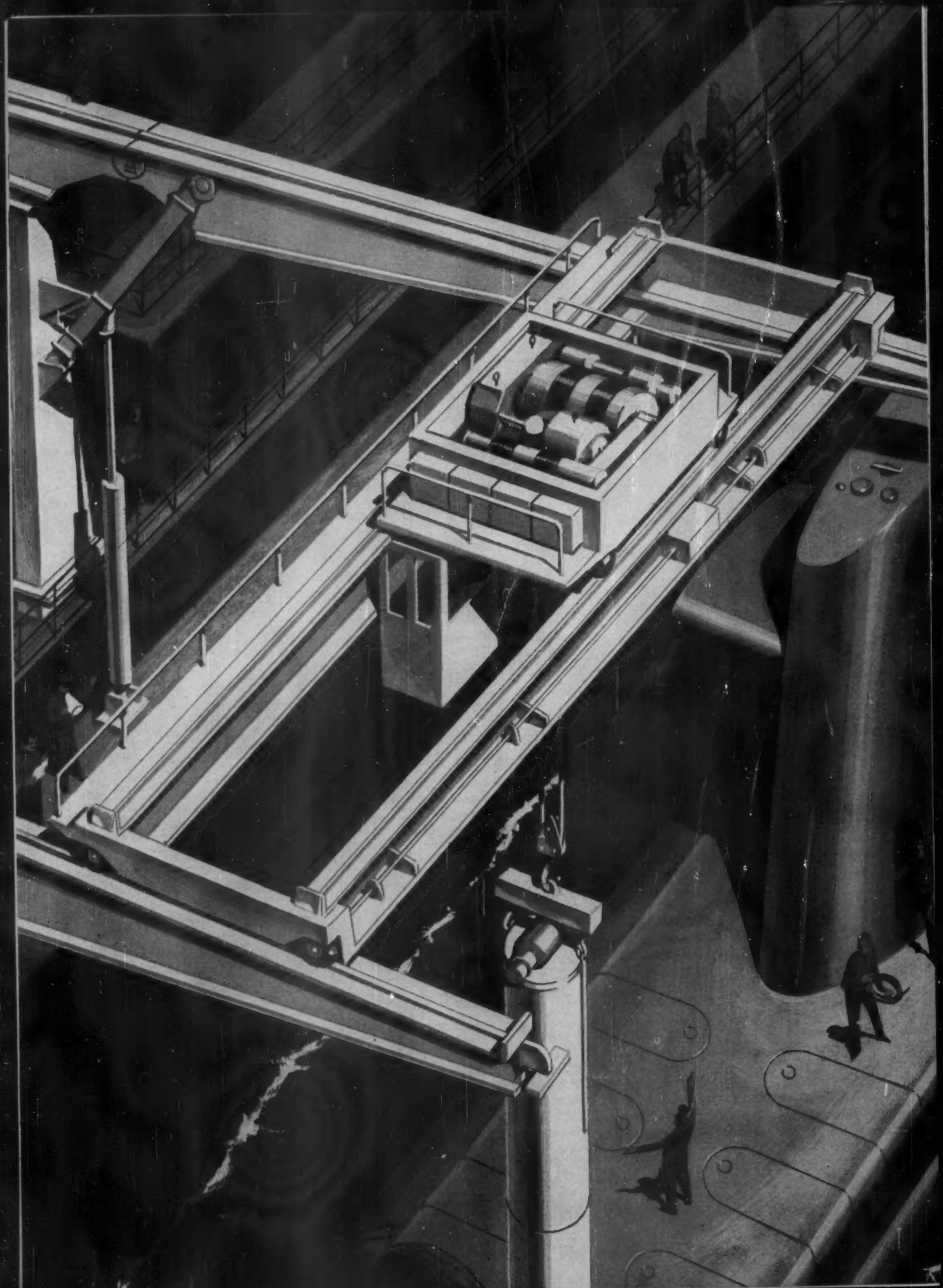

Threading the needle with a POLARIS missile using Westinghouse Load-O-Matic controls

Easing POLARIS missiles from a tender into the launching silo of an atomic submarine takes a handling system that combines ruggedness with extreme maneuverability and safe, sure, precision control—control so sensitive that the POLARIS seems to float in the air as it swings smoothly and gently into position in the submarine.

Westinghouse Load-O-Matic* crane control system was selected by Skagit Steel and Iron Works[1] for this exacting and delicate handling operation because of its unerring vernier precision performance. The combination of hoist, bridge and trolley controls operating with almost microscopic accuracy nullifies the pendulum-like swaying of the load. These positive, stepless speed controls provide movements at less than one foot *per minute*, yet will accelerate smoothly up to two feet *per second*.

The exclusive Westinghouse features which permit such precision also provide maximum reliability and minimum maintenance. Static controllers, saturable reactors and magnetic amplifiers provide stepless control and eliminate moving parts, mechanical relays and switches which corrode, wear out and require frequent maintenance. The marine-insulated a-c wound rotor motor adds additional reliability and further reduces maintenance.

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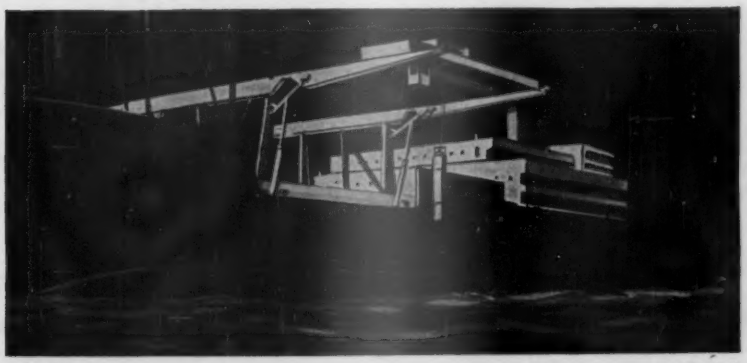
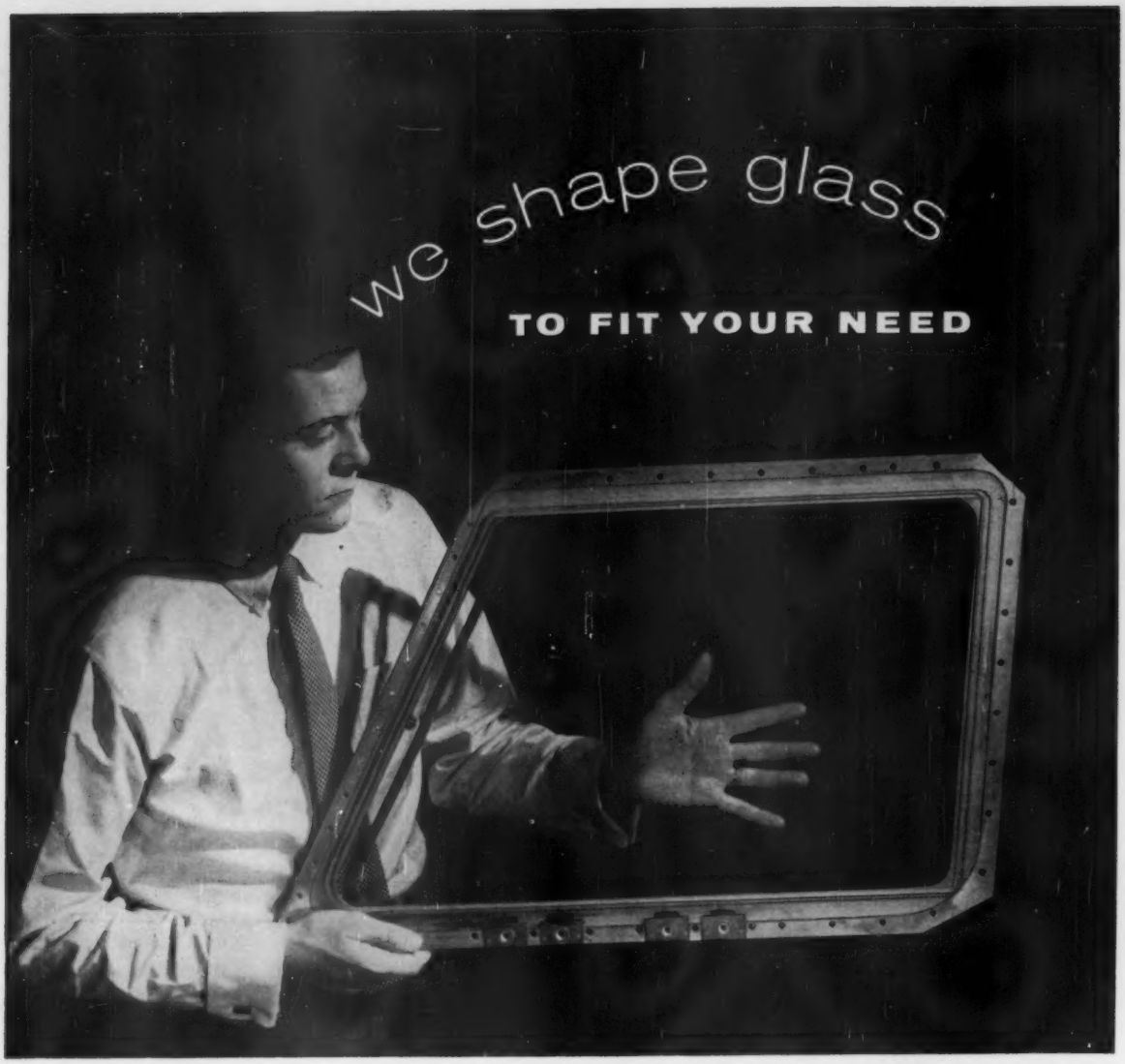


*Trade-Mark
[1]Located at Sedro Wooley, Washington.

J-02031



This is a side window panel for the Douglas DC-8 commercial jet.

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include structural engine and transmission cowling that folds down to form a maintenance platform, all electronics grouped in the glass fiber clamshells up front, and a hand operated auxiliary crane that fits into brackets in the cargo door, and can be used to remove and replace the engine, rotor blades, or transmission without outside equipment.

Swiss Fighter Choice Referred to Council

Geneva—Frequently delayed decision by the Swiss in the choice of a second-generation strike aircraft has been made at the technical level and communicated to top military and civilian levels in the Swiss government.

Final choice was made from among five aircraft: the Grumman Super Tiger and Lockheed Starfighter from the United States; French Dassault Mirage III; Italian Fiat G.91, and the Swedish Saab Draken. Technical observers report the Swiss favored the Super Tiger, Mirage and Draken based on airfield performance of these three at high-altitude mountain bases.

Some observers believe the Swiss have chosen the Mirage on the basis of its supersonic performance, airfield capabilities, lower cost than either competitor, and economic concessions made by the French with whom the Swiss have had close ties. At this writing confirmation of the final selection of aircraft type could not be obtained.

A comparative technical report was presented with the recommended choice to the Swiss council which is now studying the issue.

It is expected to come to a conclusion in a few weeks.

Ultimate choice will be made by the Swiss Parliament, hopefully in its December session but possibly not until its session of March next year.

Prospective order is for 100 airframes, powerplants and fire-control systems, plus spares.

Nuclear Emphasis Shifted by Defense

Washington—Defense Department has formally announced that the development effort in its 14-year-old aircraft nuclear propulsion program is being redirected, with emphasis being placed on the development of advanced materials and concepts. Plans for the shift were first reported by Dr. Herbert York, Defense director of research and engineering, in June (AW June 29, p. 17).

The announcement was followed by a statement from General Electric's Evendale, Ohio, Division, where work on the direct-cycle nuclear engine is being carried out, that the Defense Department decision has resulted in the immediate layoff of 68 shopworkers with a further "slight" employment re-adjustment still to come.

Atomic Energy Commission said that while the shift in emphasis will "involve some modification of the nature of the work," the change "will not materially affect the over-all scope and goal of the project. . .

"The re-orientation of the General Electric program does not result in cancellation of the contracts administered by the commission or the Air Force with General Electric. Work will continue on the development by GE of the X-211 engine system with emphasis on a powerplant more advanced and with higher performance than previously planned."

The ANP project—along with a number of other military projects—also is facing the prospect of a budget cutback, probably 10% to 15%, that would involve up to 500 employes at the Evendale facility. There now are approximately 3,500 Evendale employes working on the ANP program. In Fiscal 1959, $90 million was funded by USAF and AEC for the GE program. AEC said that a budget reduction from this level in Fiscal 1960 is "under review."

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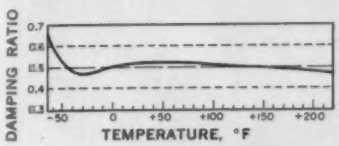
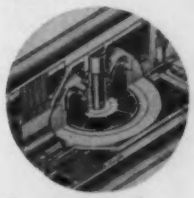


the

LONGEST LIFE



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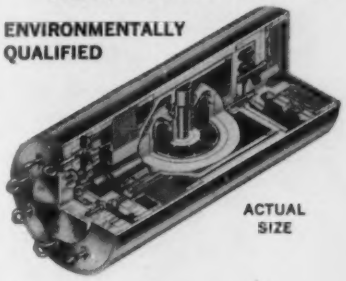

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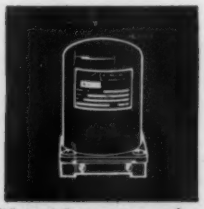
Another subsystem from Giannini...

Pitch Trim Compensator for the DC-8 Jetliner

As aircraft proceed into the Transonic Speed range, aerodynamic trim characteristics change. This change in trim requires an undue amount of attention on the part of the pilot. A small compensator system was developed by Giannini to apply continuous trim force which permits the pilot to trim the airplane in the normal manner.

The success of this small system, which was developed for use on the new Douglas DC-8 Jetliner, is largely due to the knowhow of experienced engineers and their familiarity with the Giannini precision-built components that went into its design For additional data on the Pitch Trim Compensator, send for Giannini Systems Case Study No 100.



differential pressure transducer

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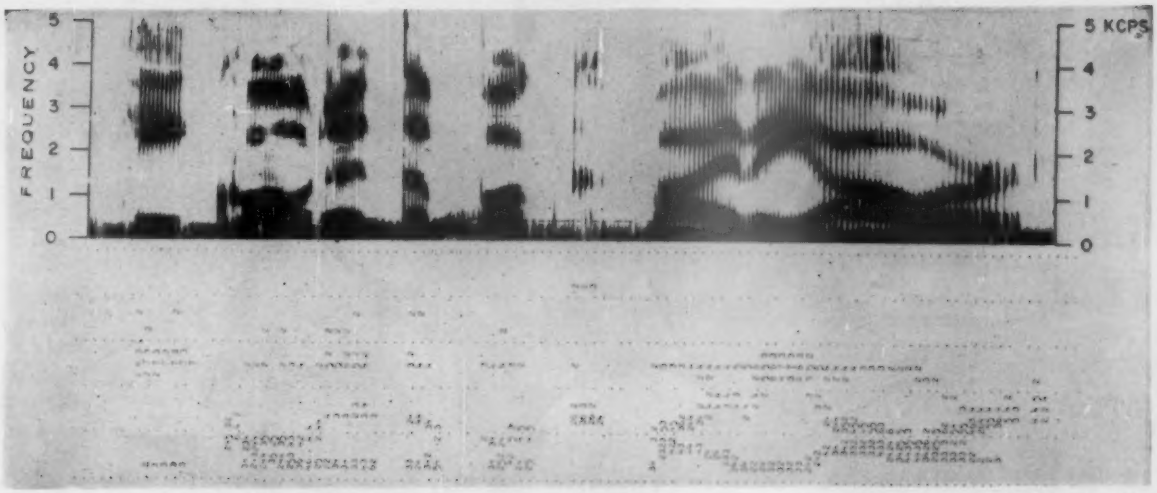
Engineering opportunities now exist at Giannini for work on similar systems. Write the Director of Technical Personnel.



SENTENCE, "He quoted the book by the hour," is shown above as it appears both as a sound spectrogram (upper section) which shows the time-frequency-intensity variations in the speaker's voice and the converted octal-numerical representation of the relative amplitudes in the frequency bands sampled by an 18-channel spectrum analyzer.

Speech Compression May Free Channels

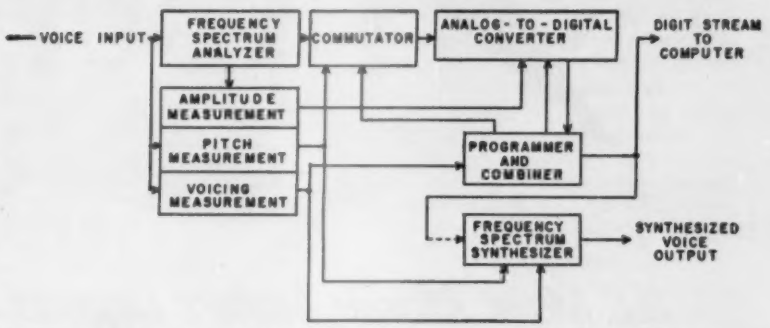
By James A. Fusca

Bedford AFB—Military need for increased communications capability has resulted in growing interest in a technique for increasing the number of available voice channels over both radio and wire circuits. Called speech compression, the technique has application also to commercial voice circuits. The possible importance of the technique can be seen from the fact that USAF has at present more than 400,000 speech channel miles of tropospheric scatter circuits alone, with many more circuit-miles scheduled for installation.

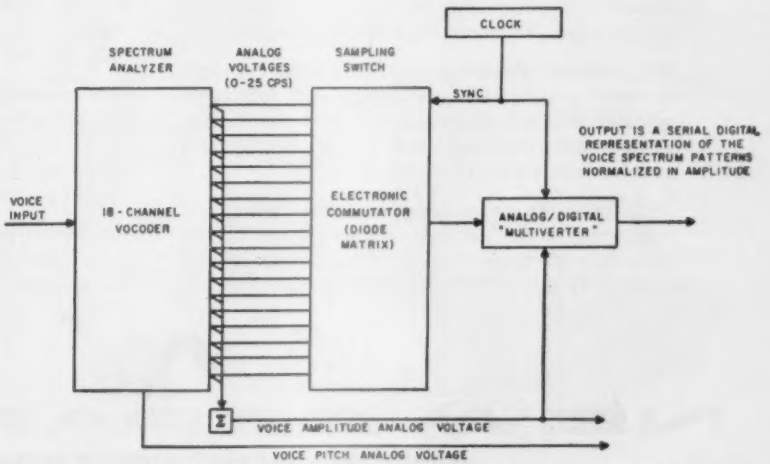
At a symposium on speech compression and processing sponsored by the Electronics Research Directorate of the Air Force Cambridge Research Center it was apparent that compression techniques have passed from the research to the development phase, with the promise of broad use of operating hardware within two to three years.

The tri-service symposium included discussions by military laboratories and their contractors and, additionally, by Bell Telephone Laboratories scientists. While military interest in speech compression has evolved from research in methods for visual display of voice messages, Bell has been exploring the commercial application of speech transmission over reduced bandwidth channels for more than 10 years.

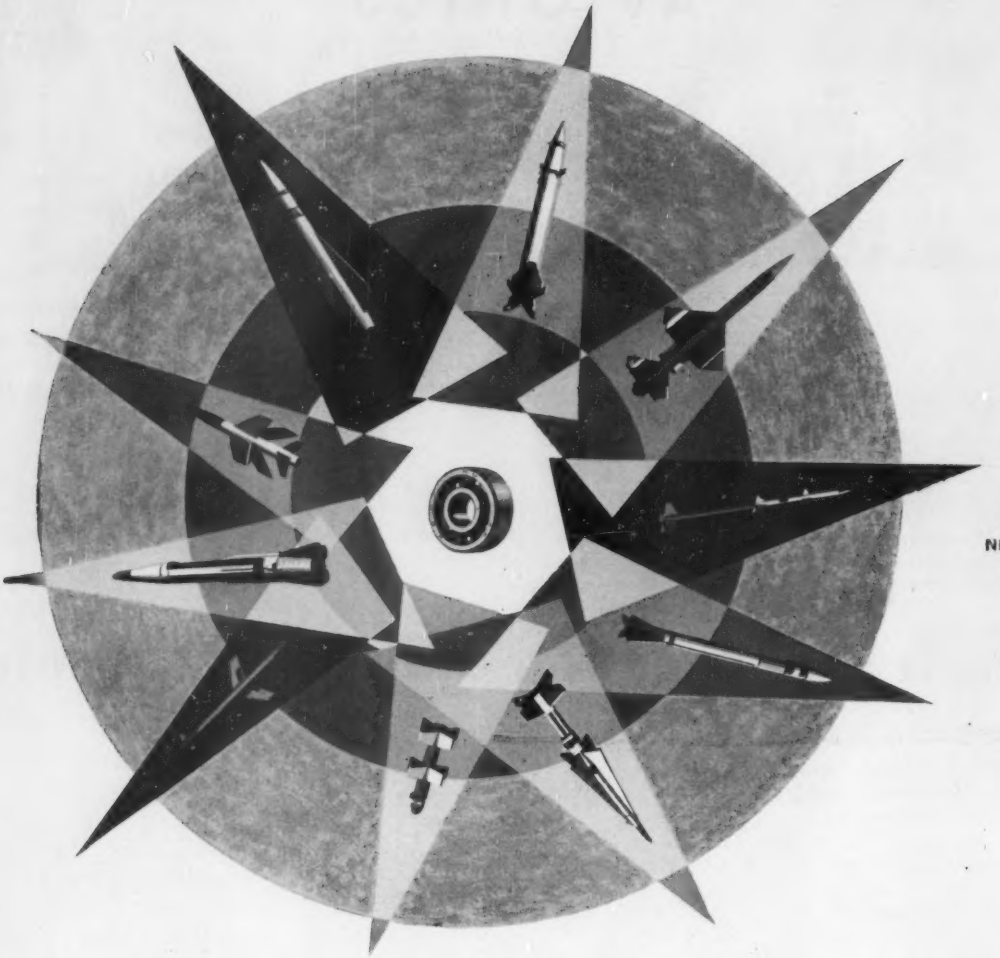
The first military efforts leading to present techniques were made by the British during World War II when they attempted to develop a method of



AFCRC approach is shown in block diagram form above. The digitized outputs from an 18-channel spectrum analyzer are programed into a computer for processing.



BLOCK DIAGRAM indicates process of converting voice spectrum patterns to digital words.



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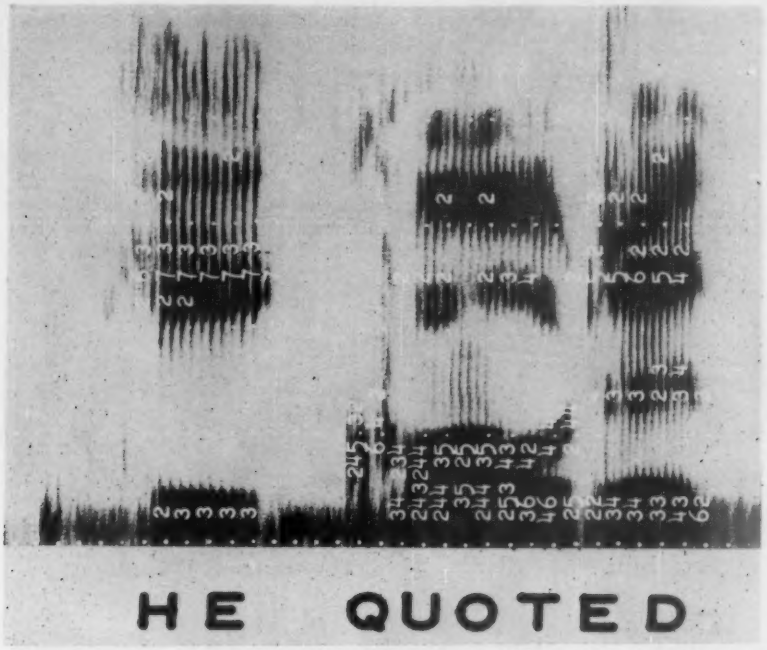


EXPANDED SECTION of sound spectrogram above has the digital format overlaid to show the effect of merging the value "one" with the value "zero." Relatively little significant speech data is lost.

controlling an aircraft cockpit display system, an early data link system, called "Fly-Bar," by voice signals from the ground. While the results were not satisfactory, the interest in visual message communication continued—evolving about 1948-49 into research studies at Air Force Cambridge Research Center on the feasibility of a phonetic typewriter, a typewriter that would accept verbal input.

Requirement Increase

During the past 10 years, however, the gigantic increase in military requirements for voice channel communications has shifted this interest to methods for transmitting voice messages at low data rates, over long distances with high reliability, and in a form that permits on-line security systems to code the transmitted messages.

Present "toll telephone quality" voice channels occupy the frequencies between 200 and 3,000 cps. This represents a transmission capacity of approximately 40,000 bits per second. A system of speech compression developed by Bell for commercial use which reduces the required transmission capacity to between 1,500 and 3,000 bits per second represents the current state of the art.

The various systems that have been studied for reducing this required transmission capacity—or required channel bandwidth—while still transmitting acceptably intelligible speech at the present time are limited at about 1,000 bits per second. Below this level, in the range between 600 and 1,000 bits per second, a breakpoint occurs in the curve indicating the percentage of errors transmitted, indicating that the intelligibility of the speech degrades rapidly.

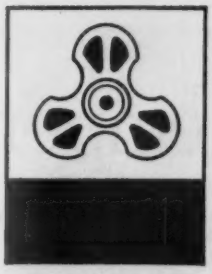
The present goal of the engineers working on this problem is to develop a practical speech compression system capable of transmitting voice messages at a bit rate between 400 and 800 bits per second.

All three services are actively interested in the development of operational hardware. The majority of the effort has been by the Air Force, with Army participation in specialized areas. The Navy, because of budgetary restrictions, has limited its participation to active monitoring of USAF and Army projects.

Two Techniques

Two basic approaches to the problems have evolved. The technique considered by most engineers in the field to be the better is called the "Vocoder" technique. Somewhat simpler in conception but more complex in actual equipment is the second approach, called the "Formant Vocoder." The term "Vocoder" is a contraction of "voice coder."

The basic vocoder technique divides the conventional 200 to 3,000 cps. voice frequency spectrum into between eight and 18 separate but contiguous frequency channels. Each channel is rectified separately and the output is filtered through a zero to 25 cycle low



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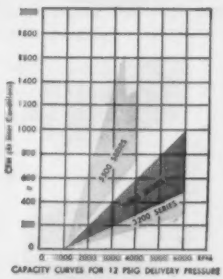

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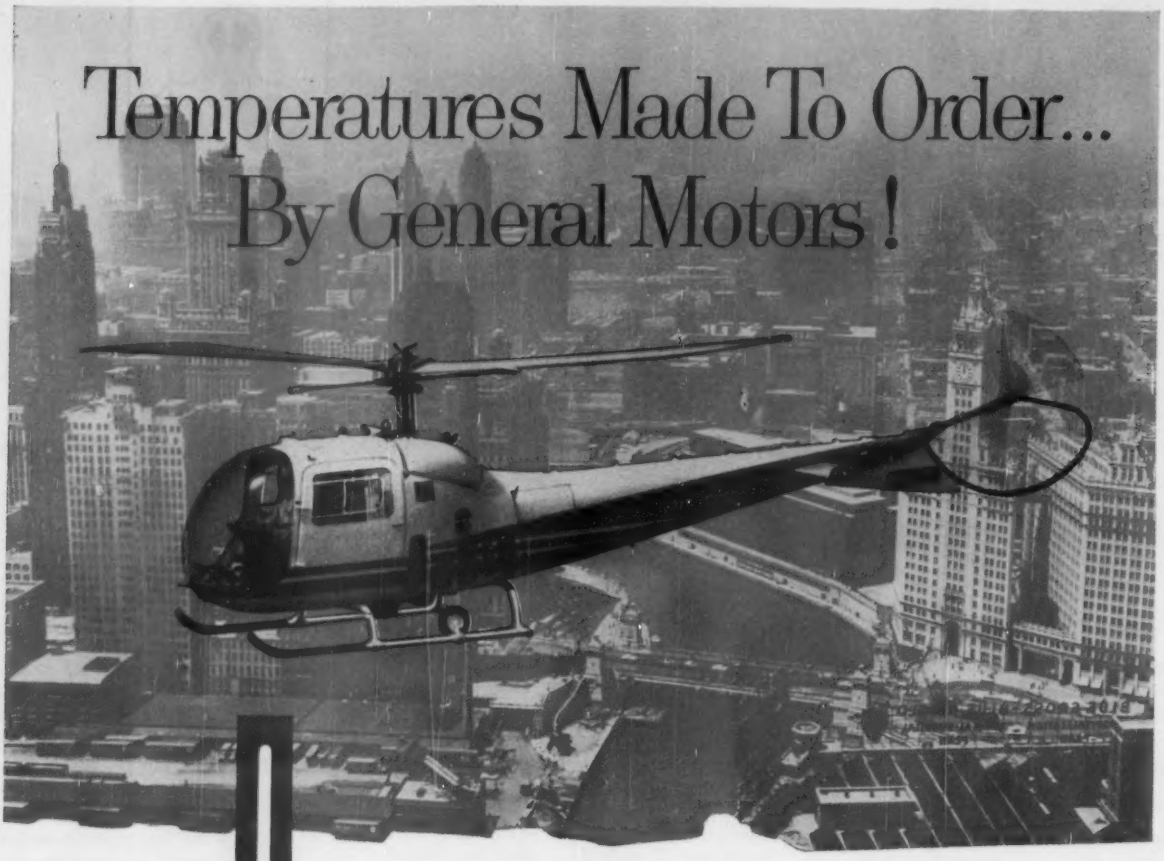

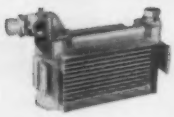

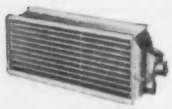

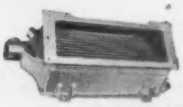

Harrison Aircraft Oil Coolers—Another Reliable Product of General Motors Research

EXCESS HEAT'S A STRANGER ON NEW BELL RANGER WITH RELIABLE HARRISON OIL COOLERS ON THE JOB!

Whether it's a swift lift or a long haul : : : the new Bell Ranger comes through with dependable performance. And Harrison keeps engine oil temperatures steady for safe, sure flights. Wherever Bell helicopters go—over mountains, marsh, jungle or desert—you'll find Harrison oil coolers on the job, guarding vital temperatures. Harrison—with a half century of experience in the heat-transfer field—is your assurance of top-quality products that are researched, designed and tested for proven reliability. If you have a cooling problem, rely on Harrison for the answer.

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AIRCRAFT, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK

pass filter and transmitted in digital form by pulse code modulation. At present each channel requires transmission of three bits per digit but this may be reduced to two bits in equipment now under development, and eventually by more sophisticated methods to one bit per digit per channel.

In addition to the filtered output of the individual voice frequency channels being transmitted, the talker's pitch is measured by means of a frequency meter and this output is filtered and transmitted also, usually by six-bit pulse code modulation. Transmission of the talker's voice pitch both increases intelligibility and provides voice recognition.

If the voice frequency spectrum to be transmitted is divided into less than eight channels, with three-bit transmission of the digital value of each channel output, the received speech becomes increasingly unintelligible. Air Force Cambridge Research Center, however, is working on the development of a system that eliminates this problem.

Research Center's Approach

If a memory bank of the essential patterns of speech is stored at both the transmitter and receiver, with each pattern identified by a serial number or address, the number of bits that must be transmitted can in theory be reduced to the range of 400 to 800 bits per second. The Air Force Cambridge Research Center now has under way a program to determine statistically what these essential speech patterns are, plus a system for simulation that will permit empiric measurement of intelligibility.

The center's approach was described by Caldwell P. Smith, electronic scientist of the Information Compression Section, Electronics Research Directorate, AFCRC, who developed the theoretical background on which the program is based. One of the chairmen of the symposium was Weiant Wathen-Dunn who heads the Information Compression Section.

To provide the statistical data for determining the essential speech patterns to be stored, Air Force Cambridge Research Center has contracted with Melpar, Inc., for the design and development of a voice data processing system to be delivered early next year. This system will accept speech input from a conventional vocoder and sort and compile voice patterns in real time while simultaneously keeping track of the number of recurrences of each individual pattern.

These stored patterns will be used to simulate a discrete speech compression channel while, additionally, allowing the simulation of digital errors so that their effect in degrading the speech transmitted by the system can be determined. Simulation of transmitted errors is a key part of the study because

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...the Deutsch snap-in contact, of course—guaranteed to withstand 25 pounds pull. In Deutsch DS miniature connectors, each pin and socket is locked in place by an exclusive, patented spring mechanism.

WHAT'S MORE...Deutsch-designed tools whip the problem of fast, reliable crimping (hand or automatic)—insertion and removal.

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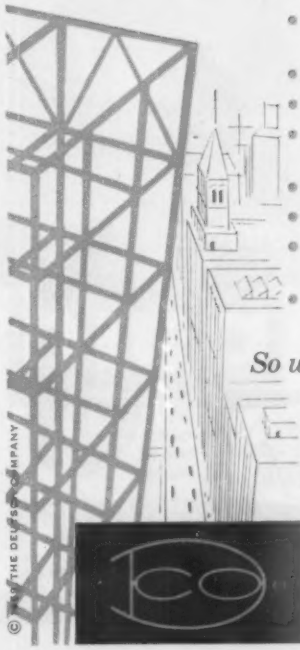
- Deutsch-designed crimp, stronger than the wire itself (AN #18 wire and smaller)
- 7 shell sizes, with alternate clocking and insert arrangements
- exclusive Deutsch ball-lock coupling
- superior interfacial seal
- silicone inserts; no shrinkage, bonding or reversion
- temperature range −67° to in excess of 300° F
- seal before electrical contact
- interchangeable with existing Deutsch DM (MS) miniatures and hermetics
- meet all applicable requirements of MIL-C-26482



So why worry? For details on completely reliable snap-in type connectors, contact your local Deutsch representative or write for data file H-10.

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100 MILES UP Pacific KEEPS THE SLACK OUT OF THE REINS!

WITH 6 CABLE CONTROL REGULATORS ON THE X-15!

YAW CONTROL Regulator

PITCH and ROLL CONTROL Regulator —left hand

PITCH and ROLL CONTROL Regulator— right hand

SPEED BRAKE CONTROL Regulator

REACTION CONTROL Regulator

FUEL VALVE CONTROL Regulator

Pacific Regulators were chosen to keep perfect tension in control cables for instant control response on the X-15. For good reason, too. Hypersonic speeds can cause air friction to heat surfaces to 1000°F in seconds. LOX drops metals to frigid lows of −300°F. Cold refrigerated air roars through wing and fuselage areas.

Such temperature extremes cause rapidly changing expansion differences between airframe and control cables. These variations must be compensated for in the control cables to prevent them from rapidly becoming too taut or slack. *And only Pacific Cable Tension Regulators can supply the necessary instant . . . automatic . . . positive compensation required.*

Pacific Regulators compensate for *thermal or mechanical* variations in control systems as swiftly as changes occur. They keep control cables at a constant even tension insuring instant control response.

Pacific Regulators also permit rigging cables at a lower load, thus reducing rig friction that could mask small control corrections. Pacific Regulators are in use on all types of aircraft from lighter-than-air to faster-than-sound. There is no match for their versatility. For complete information write Pacific today.

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Creative Development and Manufacturing in Airborne Controls Design

an operational system must tolerate 1-2% errors without intelligibility loss.

The second technique for compressing the normal voice frequency channel for narrow band transmission employs the natural resonance modes of the voice—the patterns of increased intensity of certain voice frequencies caused by nasal and sinus resonance. Only the principal three modes are important, so that by transmitting formant patterns of the talker's voice the voice patterns can be reconstructed at the receiving end.

Although these are the two most promising methods of speech compression at present for communications purposes, the similar but separate problem of speech recognition is being attacked by other and more general methods. Speech recognition systems have application in the voice instruction of computers or phonetic typewriters.

Air Force efforts in speech compression are divided between Air Force Cambridge Research Center, which has the responsibility for basic research in this area; Rome Air Development Center, which develops ground-based speech compression equipment; and Wright Air Development Center, which develops airborne equipment.

With the exception of two WADC and one RADC contractors, AFCRC is at present supporting the major industry effort in research and development of the techniques for military purposes. These contracts are:

• **Massachusetts Institute** of Technology which holds a $40,000 contract for basic studies in speech.

• **Royal Institute of Stockholm** which holds a $12,000 contract for study of techniques of speech analysis and speech synthesis.

• **University College,** Phonetics Department, in London, holds a $12,000 contract for studying problems of the phonetic typewriter. Employing a statistical approach, the probability of specific speech patterns occurring is stored so that machine decision is based on statistical measurement plus "best estimate" of the most likely next occurrence. At present the typewriter has been programed for 20 sounds and has achieved 80% correct decisions when calibrated for a particular speaker.

• **Melpar, Inc.,** which has a contract for $112,000 to design and build the digital voice data processor.

• **Radio Corp. of America** is studying under a $75,000 contract analog instrumentation for storing speech patterns and making selections. RCA is also studying the problem of establishing USAF requirements as to how good speech intelligibility, voice quality, and talker recognition must be for operational systems.

The two WADC contracts are with

Melpar for the redesigning of existing formant vocoder equipment into a solid state digitalized airborne package, and with RCA for further studies of speech recognition. The extant RADC contract is with Scope, Inc., for studies of speech recognition as applied to a simplified formant vocoder.

In the approach proposed by Air Force Cambridge Research Center voice information is transmitted in message units of a statistical nature. Each message word consists of two items: a serial number or address which designates a voice frequency spectrum pattern in time, frequency, and amplitude; and an additional serial number that designates a vowel pitch pattern in time and frequency.

At the voice message source, analyzer equipment performs selective decisions in comparing the voice signal with stored memory data and, using control logic, extracting the appropriate serial number for transmission.

At the receiver, the serial numbers, function as addresses which select from the memory unit there the signal parameters and control logic to operate a speech synthesizer.

In the experimental setup at Air Force Cambridge Research Center, the output of an 18-channel spectrum analyzer is digitized and the digit stream is programed into the AFCRC computer. Three bits are used per spectrum channel, or a total of 54 bits from each spectrum pattern. These samples occur every 1/50 sec., and the data can be printed out on a sound spectrogram. The amplitude values are printed out as octal numbers, representing relative amplitudes in the 18 channels of the spectrum analyzer, with zero left blank.

In the print-out program frequency indices are inserted, plus spaces to make the frequency scale approximately linear

Sugar Grove Telescope Site Takes Shape

Foundations for Naval Research Laboratory's 600-ft. dia. radio telescope are being laid near Sugar Grove, W. Va. (AW Oct. 5, p. 115); complex will be completed in 1962. Instrument in wooded area (upper right) is 60-ft. radio telescope used to seek out sources of electric noise which interfere with reception in large radio telescopes.

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general characteristics

Maximum rated flow	**valve pressure drop**	
	1000 psi	**3000 psi**
Series 31	**4 gpm**	**7 gpm**
Series 32	**8 gpm**	**14 gpm**
Operating supply pressure	**50 psi to 4000 psi**	
Electrical signal power	**40 milliwatts minimum**	
Temperature range (fluid and ambient)	**—65°F to 350°F standard, to 450°F or 600°F on special order**	
Resolution	**<½%**	
Hysteresis	**<3%**	
Null shift		
temperature —65°F to 450°F	**<4%**	
acceleration to 50g	**<5%**	
supply pressure 80% to 100%	**<2%**	
quiescent current 50% to 200% rated current	**<2%**	
back pressure 0% to 20% of supply	**<2%**	
Weight (approximate)	**0.75 pounds**	

series 31 and 32

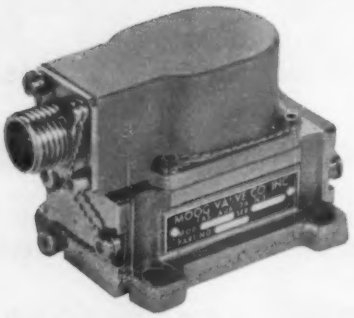
flow control

servovalves

with mechanical feedback

from

MOOG:



Series 31 and 32 servovalves are miniaturized two-stage flow-control valves which utilize internal mechanical feedback. Features of the new design include high performance, simplification and compactness, together with a wide temperature capability. Specific valve characteristics can be achieved other than the ones listed above.

Write for catalog 310 and individual model data sheets that illustrate typical performance variations.

MOOG SERVOCONTROLS, INC. PRONER AIRPORT, EAST AURORA, N. Y.

LEADING INNOVATOR AND PRODUCER OF ADVANCED ELECTROHYDRAULIC SERVOVALVES

so that it will match the linear scale of a conventional spectrogram. Amplitude values are normalized.

Analog voltages from the channels of the spectrum analyzer are summed to generate an analog voltage proportional to speech amplitude. This analog parameter is used as a floating reference voltage for the analog-to-digital converter, which causes it to act as a quotient device. The result is that the amplitude level in each spectrum channel is digitized as a ratio with respect to the mean amplitude. A separate threshold measurement converts the digital output to zero for one complete frame of data whenever the voice amplitude falls below a prescribed value.

Two advantages are achieved by amplitude normalization of the digital data in this manner. First, a wide dynamic range in the input voice signal is easily accommodated without loss of resolution of the individual signal patterns, whether due to consonant sounds or vowel sounds. Secondly, the spectrum pattern of a particular sound event tends to remain constant with changes in voice amplitude.

These spectrum patterns are digitized using a ratio scale spaced in approximately 3-db. steps for the octal values from two to seven, and a 6-db. increment for the value one, giving a 24-db. range for the spectrum patterns. The logarithmic scale is generated by a diode matrix which acts as a "lockup" table. A four bit linear code is generated originally from which the matrix selects eight values that generate the three-bit output code. This establishes seven values and a zero on the octal scale.

Work with this system showed that the value one had a marginal value because it often occurred well down in the secondary structure of the spectrum patterns. By merging the value one with the value zero the pattern range was reduced from 24 db. to 18 db. Because only six numbers are printed rather than seven, the digital pattern is simplified without any significant loss of detail.

The voice data processing system being developed by Melpar will be used by Air Force Cambridge Research Center to accumulate and sort a very large number of speech sounds to provide statistically a record of essential voice sounds. This will be accomplished by insertion of the digitized voice data into a memory unit that will provide a record of the number of occurrences of discrete sound patterns.

The primary function of the Melpar system will be the establishment of design parameters for a practical communications system based on the data compiled. The design of the system, however, is such that the functional capabilities of the optimized system can be simulated. The functions of the system will be to provide real time sorting and counting of spectrum pattern descriptions as generated by a vocoder and quantizer, to enable determination of the number of different spectrum patterns used in speech, estimation of the relative frequency of occurrence of each of these patterns, determine the effect of speaker-to-speaker variations, and the degree to which approximations may be used without degrading intelligibility and speaker identity. To explore further the effects upon intelligibility and speaker identity, the system will provide for recording and reproducing sequences of compressed speech—spectrum pattern addresses and voice pitch—for fine analysis.

With the system it will be possible to simulate a complete communications channel, including compression, expansion, and introduction of transmission errors between compression and expansion, which will permit complete evaluation of the communications system without the need for a breadboard phase.

The voice data processing system is, in effect, a special-purpose transistorized digital computer. In addition to standard logic modules, the computer employs for storage a 650,000 bit, 425 kc. Bryant magnetic drum which will provide for sorting and storage of up to 4,096 occurrences of each of up to 4,096 different spectrum patterns.

testing facilities include

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Interested in precision machined parts? . . . Bliss machines rocket and missile nose cones, domes and cylinders, large diameter thin-walled pieces that must be held to wall thickness tolerances of ±.002".

. . . Or atomic assemblies and components? . . . Reactor core lifting and other core handling equipment, welded pressure vessels and small machined parts are all produced by Bliss.

Projects with more than a touch of the unusual? . . . Most U. S. Navy carriers have Bliss-built catapults . . . Just recently a Bliss overrun barrier saved both pilot and plane when a jet's brakes failed . . . Right now you'll find sections of what will be the world's most powerful radio telescope being assembled on the 600,000-square-foot floor of the Canton plant, one of ten Bliss plants in the U. S. In a word, Bliss has the facilities and skills to take any job involving metal manufacturing from plan to finished product.

Whether you need a complete turn-key plant or quantities of precision machined parts, large or small, you'll be wise to get a bid from Bliss.

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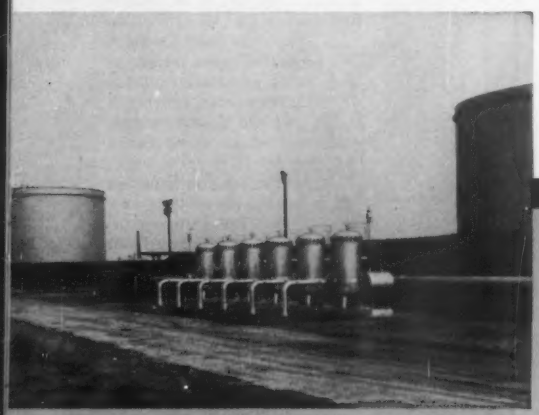
BLISS
SINCE 1857

THE RULE FOR FUEL AT IDLEWILD . .

Tanker illustrated is unloading fuel through 1200 G.P.M. filter-separators to bulk tank storage at Idlewild dock facilities.



Six 1200 G.P.M. units at Idlewild are shown at the bulk plant site.

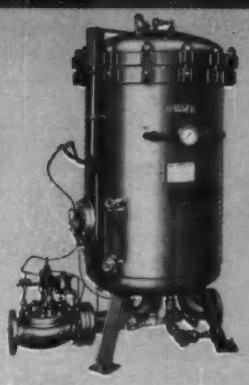
At New York International Airport (Idlewild), operated by the Port of New York Authority, **James P. O'Donnell** and his staff of engineers together with the **Port of New York Authority** Engineering and Aviation Departments, plan, design and specify fuel handling equipment installations which are supervised and operated by Allied New York Services, a subsidiary of Allied Maintenance Corporation.

Teamwork of experienced management and carefully trained personnel assures that aircraft are efficiently refueled with clean, dry, fuels as specified by the 21 U.S. and 23 foreign carriers served at Idlewild.

BOWSER
ESTABLISHED 1885

FILTER-SEPARATORS

Bowser Filter-Separators are available as manual and fully automatic equipment for tank farms, bulk transfer and airport hydrant systems. Available in metal to specifications for gasoline, kerosene, jet and similar fuels.



Complete data for fixed or mounted Briggs and Bowser Filter-Separators may be had on request from . . . . .

"...when you move it, CLEAN IT!"

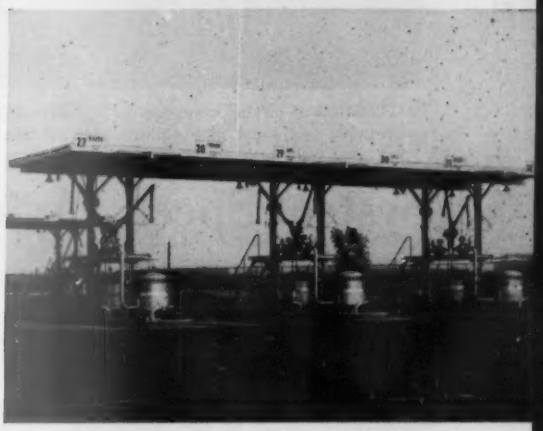
Contamination of jet fuel can occur wherever it is stored and whenever it is transported. For safety and protection of passengers and jet equipment, contaminants are removed by providing "settling" time during bulk storage and also by several "dry-cleaning" operations to remove dirt and water.

The filter-separators used at Idlewild are identical in design and function to those specified and approved by the military to remove fuel contaminants.

PRODUCT OF BOWSER RESEARCH

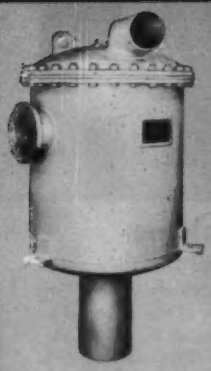
BOWSER-BRIGGS EQUIPMENT MEETS MILITARY REQUIREMENTS

Refueling a Boeing 707 at Idlewild. TRUCK-MOUNTED FILTER-SEPARATOR IS A 600 G.P.M. UNIT.



All fuel from bulk storage tanks is "dry-cleaned" a second time at truck loading racks. This step follows the contaminant removal effected by settling time provided during bulk storage.

Each truck refueler is equipped with a 600 G.P.M. filter-separator to reclean fuel as it enters the aircraft.



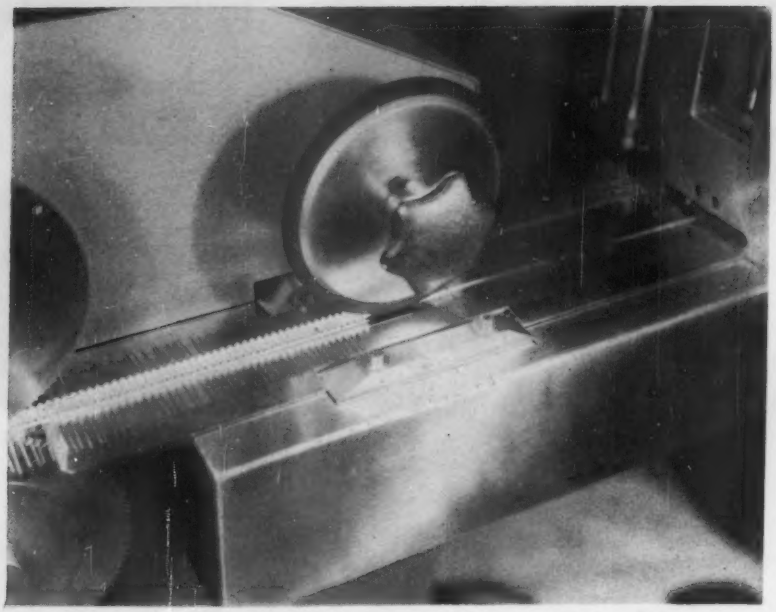
Briggs

PIONEERS IN MODERN OIL FILTRATION

FILTER-SEPARATORS

Briggs Filter-Separators are available for fixed installation and as truck or cart-mounted units in stainless steel or metal to specifications and in capacity required.

OWSER INC., MARKETING DIVISION, Fort Wayne, Ind.



PACKAGING of electric components by International Resistance Corp. method occurs as components and paper pass through gears at left, then through pressure wheel at right.

System Speeds Avionic Packaging

Los Angeles—New approach to the problem of packaging small electronic components for high-speed assembly lines being marketed by International Resistance Co., named Grip Strip, offers production savings and improved inventory control. The method was originally designed by IRC for packaging of its own components and is now being used at Hughes' Products Division here.

Grip Strip is essentially a channel-shaped continuous strip of specially-treated paper with patented "fingers" along its sides to grasp the components firmly, by their leads, yet near the bodies. Strips may be cut for packages of 20, 50 or any desired number of units, or a strip may be wound on a reel of up to 2,500 units.

Advantages of Grip Strip to components and equipment manufacturers are:

- **High production rate.**
- **Low handling costs.**
- **Good inventory control.**
- **Good orientation** and more secure retention of components.

Another advantage of Grip Strip packaging is that leads can be cut and formed simultaneously while still held in the strip. Components cannot fall out of the holder accidentally, yet can be released quickly and easily when needed. Strips are adaptable to automatic insertion equipment such as is used with etched circuit boards.

Machine for packaging components in the Grip Strip method can be leased or purchased from IRC. About four months ago Hughes Aircraft Products Division installed the equipment for packaging diodes. On a two-shift basis, with two operators, Hughes has increased production of packaging diodes to 3,000 pieces per hour, or ¼ million diodes per machine. Thus, per unit cost of packaging has been reduced, and Hughes has realized $1,200 labor cost saving per million diodes packaged. Machinery has a reserve capability which will enable it nearly to quadruple its present rate if needed.

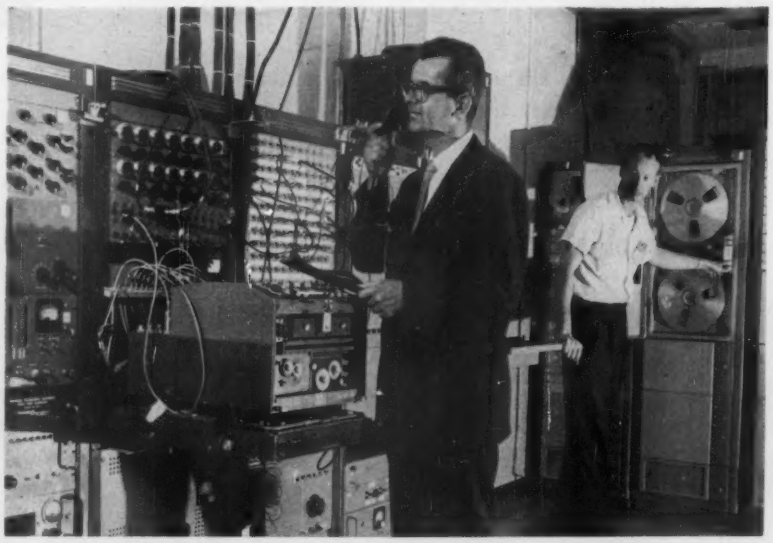
Other manufacturers presently using components packaged by IRC in Grip Strip method are Radio Corp. of America and Bendix. With slight modification machine can package such components as resistors, transistors or diodes.

Los Angeles Revises Jet Approach Plan

Los Angeles—Revised approach procedure for jet transports is in effect at the Los Angeles International Airport in conjunction with elevation of the instrument glide slope from 2¾ to 3 deg.

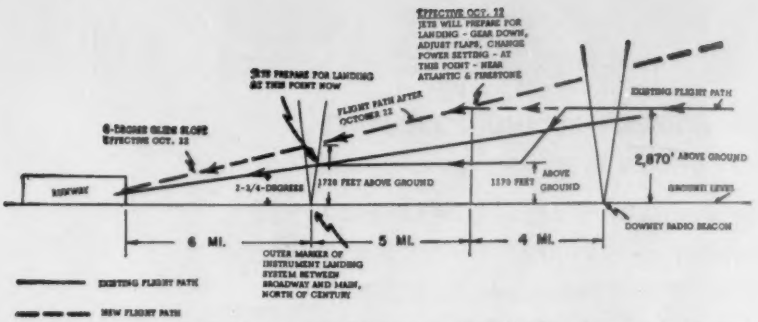
New procedure enables jet transport pilots to prepare aircraft for landing over the intersection of Atlantic and Firestone Boulevards at an altitude of 2,870 ft. above ground and some 5 mi. east of the present location used for this operation.

New procedures were devised to bring in the airplanes at a higher angle, and to give pilots additional time and altitude to prepare for landing. Los An-



Telemetry Data Relayed by Telephone

Data processing system engineers of Boeing Airplane Co.'s Aero-Space Division transmit telemetered data between Florida and Seattle, Wash., by telephone to reduce elapsed time between Bomarc missile test flights and production of flight test data. Data recorded on magnetic tape at 60 in. per sec. is played back at the acquisition station at 1⅞ in. per sec., reducing frequency and compressing bandwidth by a factor of 32:1. Frequency modulatiton data is available for analysis within four hours of flight termination, as against two or three days normally required when tape recordings are airlifted.


EFFECTIVE OCT. 22
JETS WILL PREPARE FOR LANDING - GEAR DOWN, ADJUST FLAPS, CHANGE POWER SETTING - AT THIS POINT - NEAR ATLANTIC & FIRESTONE
JETS PREPARE FOR LANDING AT THIS POINT NOW
FLIGHT PATH AFTER OCTOBER 22
EXISTING FLIGHT PATH
6-CROSS GLIDE SLOPE EFFECTIVE OCT. 22
2,870' ABOVE GROUND
RUNWAY
2-3/4-DEGREES
1720 FEET ABOVE GROUND
1570 FEET ABOVE GROUND
GROUND LEVEL
DOWNEY RADIO BEACON
6 MI.
5 MI.
4 MI.
OUTER MARKER OF INSTRUMENT LANDING SYSTEM BETWEEN BROADWAY AND MAIN, NORTH OF CENTURY
EXISTING FLIGHT PATH
NEW FLIGHT PATH

CHANGED approach procedure for jet transports at Los Angeles Airport will bring the airplanes in at a higher angle, giving pilots more time and altitude to prepare for landing. Instrument glide slope is elevated from 2¾ to 3 deg. Los Angeles Sound Abatement Coordinating Committee hopes changes will reduce complaints about jet noise.

geles Sound Abatement Coordinating Committee hopes these changes will bring appreciable relief from "unpleasant sounds" caused by jet aircraft.

Lowering of landing gear, adjustment of flaps for reduction of speed, changing of engine power settings and establishment of the descent rate (approximately 700 fpm.) are accomplished over the outer marker (radio beacon) located between Broadway and Main, just north of Century Boulevard, and are effected at 1,570 ft. above the terrain.

Changes in glide slope elevation and approach procedure were designed by the regional office of the Federal Aviation Agency as part of a community-wide sound abatement program and have the support of the Air Line Pilots Assn. and the airlines.

Lockheed Proposes Low-Cost Automatic Position Reporter

Los Angeles—Low-cost air traffic control automatic position reporting system based on beaconry techniques is proposed by Lockheed Electronics and Avionics Division.

System is named Lockheed Tracking and Control System (Loctracs) and is reported to be completely within the present state of the art.

"Installation of service units could begin in late 1962, given an early go-ahead and consistent government support," according to M. C. Haddon, general manager of the division. Haddon said 630 units could provide blanket en route coverage for the U. S. and another 70 units would be recommended for more precise position reporting in terminal areas. Lockheed estimates nation-wide ground installations could be set up for about $700 million, including site preparation, buildings, access roads, etc. Equipment itself would account for $280 million of the total.

To equip all aircraft with Loctracs beacons would require another $30.5 million, he said.

Airborne unit for lightplanes would cost about $250, Lockheed says; military and airline units would be priced at about $600. Cost of equipment for a single Loctracs ground installation would range from $400,000 to $450,000 depending on traffic load in its sector. System for a light-traffic sector would not need as many decoding units as one on a more heavily traveled route. Decoder modules can be added or removed to keep pace with traffic trends.

Loctracs would use a completely passive ground system. Airborne beacons continuously transmit pulse-coded identification and altitude signals, placing all aircraft under surveillance whether or not a flight plan is filed. This would eliminate complexity and cost of radar or two-way communication devices involving roll-call by ground station and automatic response by airborne transponder. Being passive, it could not be used as a navigation aid by enemy aircraft.

It supplies information which an air traffic control computer can use to predict collision hazard and traffic congestion, Lockheed says.

Ground Installation

Ground installation consists of four receivers spaced near corners of the rough, quadrilateral sector which it serves. Their relative position can be accommodated to terrain. Beacon signal from an aircraft in the sector is picked up by all receivers and carried to surveillance center by microwave or cable relay net where fixed delay lines exactly equalize time required for signals to be relayed from receivers to equipment in the center. Any remaining difference in time of signal arrival via the four paths is due to differences in distance between the airplane and the various receivers.

For each receiver, there is a digital delay line in surveillance center. Each digital delay line has taps at one microsecond intervals. The relayed pulse in each of the four digital delay lines would fall into the tap appropriate to its time of arrival. The four pulses arriving from the four receivers can be brought into time coincidence for every combination of four taps, and every combination has a single coincidence detector which will accept no other combination.

Each coincidence detector represents a geographic block within the sector known as a surveillance element. When a combination of digital delay taps enters a signal in the appropriate coincidence detector, it is known that an airplane is transmitting in that element. A display light is automatically turned on at the proper surveillance element on the sector map and a data pulse is fed to the data readout. Quadruple correlation separates signals of many aircraft despite simultaneous, unsynchronized transmissions.

Surveillance Elements

Surveillance elements may be as small as ¼-mi. square but more typically would be one mile square. Size could be varied according to traffic density. Loctracs en route sectors would measure from 70 to 100 mi. on a side. Terminal sectors and the elements within them would be smaller for more precise tracking right down to the runway in dense traffic. Sector might be as small as 25 mi. on a side.

Loctracs could distinguish between more than 1,000 aircraft per sector in any one moment.

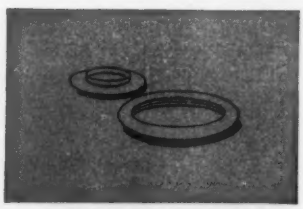
Transmitter in the airplane would weigh from three to five pounds and fill only 200 cu. in. of volume. It would generate 600 position pulses and 35 identification and altitude code signals per minute. Altitude reporting increments might vary from 60 ft. at altitudes measured in thousands of feet, to 6,000 ft. at altitudes measured in hundred thousands of feet. Altitude data will be derived from fixed reference aneroid altimeters which cannot be adjusted to compensate for local barometric pressure variations.

Duty cycle of airborne beacon will be small—transmitting only .001% of the time.

Last nine bits in the 36-pulse train are spares for optional canned messages such as destination or emergency declaration. Six-bit altitude code indicates one of 64 altitude layers.

Seventeen-pulse identification sequence recognizes 130,000 different call signs. Monitor circuit would tell pilot of a failure.

Garlock's unique position in the missiles



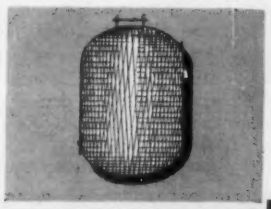
GARLOCK METAL FITTINGS FOR ROCKET MOTOR CASES such as blast tube and thrust terminator support rings are machined to extremely close tolerances. Made from special materials affording minimum weight, maximum strength and rigidity.

industry . . .

GARLOCK'S UNIQUE POSITION in the missles industry may be of infinite value to you.

ACCEPTANCE: Right now Garlock is supplying rocket motor components for various phases of development and production of seven different missiles. **FLEXIBILITY:** Garlock has the people, the equipment, and the experience to swing into prototype production on short notice, and to follow this with full-scale production as needed. **DIVERSIFIED ABILITIES:** Garlock is thoroughly familiar with the design and manufacture of components from a wide range of basic materials—metals, rubber, phenolics, fluorocarbons and other plastics. **COMPLETELY INTEGRATED STAFF:** Garlock's product design, tool design, pilot manufacturing and production staffs are completely integrated for efficient handling of a project from start to finish. Garlock engineers will work to your design—or with you in developing designs. Write or call Military Products, The Garlock Packing Company, Palmyra, New York. GARLOCK

MISSILE PARTS FROM INERT MATERIALS include newly developed asbestos-phenolic compound for nozzles . . . nose cones of fluorocarbon plastics.

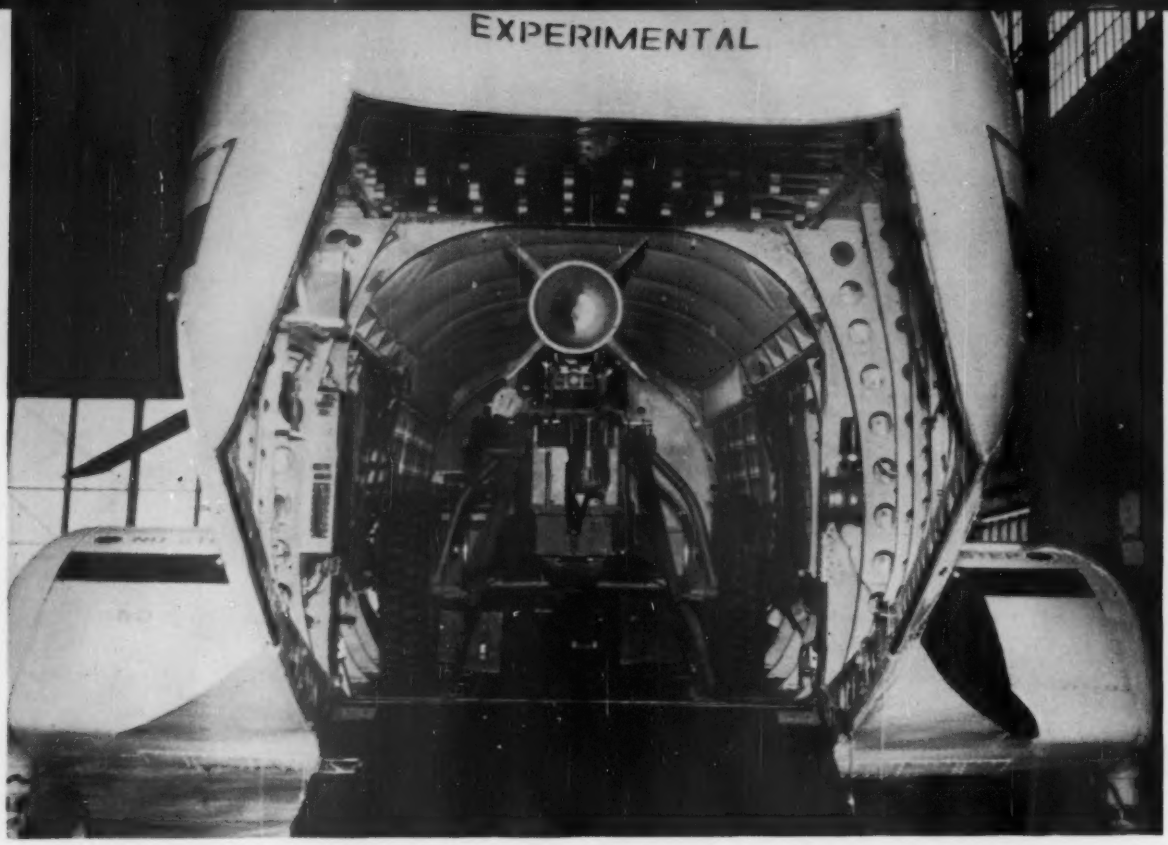


FILAMENT WOUND ROCKET MOTOR CASES made by exclusive Garlock method results in structure much lighter and stronger than steel.

INSULATION FOR SOLID FUEL ROCKET MOTORS made by Garlock is rubber-like compound which encounters gas velocities of Mach 3, temperatures to 5500°F, prolonged ambient temperatures of 300°F.

Garlock components are presently used in the development and production of:

Vanguard	Minuteman	Super Tartar	Polaris
Super Vanguard	Nike Hercules	Terrier	

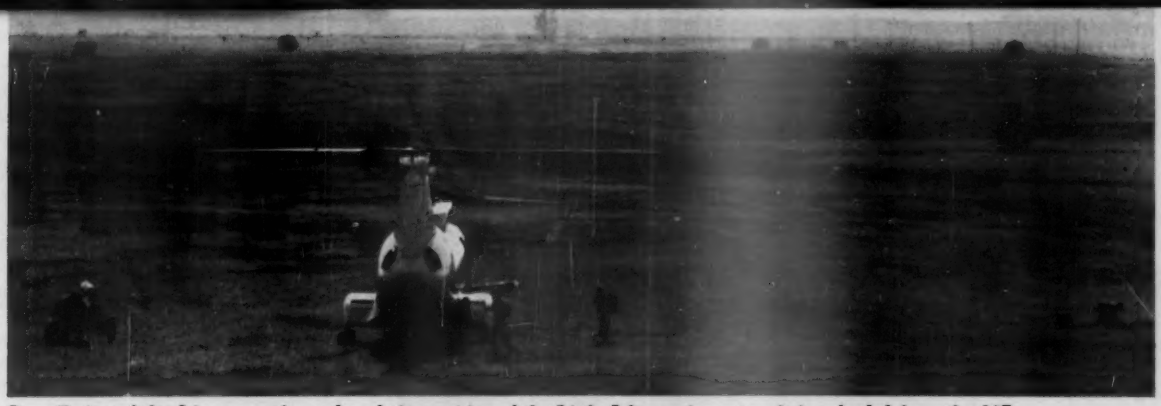


Little John rocket on launcher is loaded in Vertol 107 prototype tandem-rotor, twin-turbine helicopter. Rocket on launcher weighs 2,100 lb. Total weight of the system, including an eight-man launching crew, is 4,200 lb.

Vertol 107 Demonstrates Field Missile Delivery

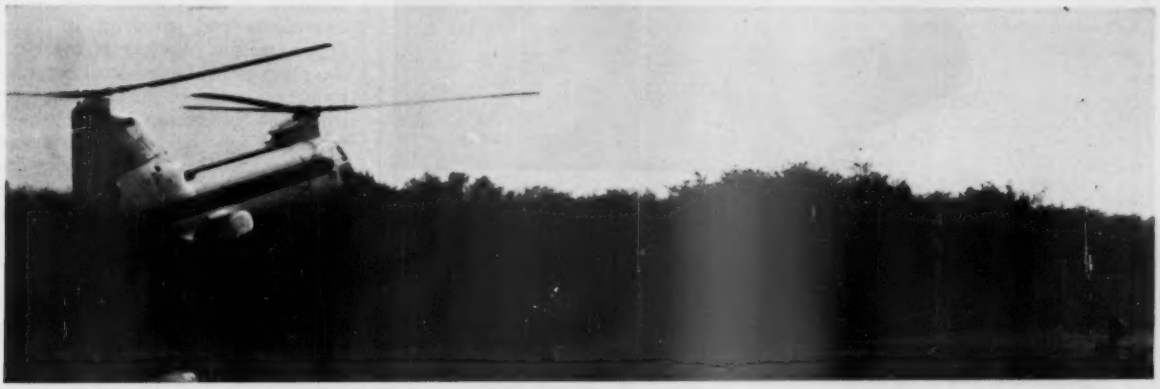
Vertol Aircraft Corp.'s Model 107 prototype twin-turbine helicopter demonstrated tactical air mobility of the Little John missile system at the American Ordnance Assn. demonstrations at Aberdeen Proving Ground earlier this month. Actual unloading and setting up of equipment for launching took 8 min. This was the first time a Little John launching crew was teamed in one helicopter, with all equipment loaded internally. During actual firing operations the helicopter remained about 100 yd. away from the rocket. After firing, the launcher is aft-loaded; wind measuring device is loaded through forward cabin door.

Launching crew (below, right) prepares Little John for launching while wind-measuring device crew (below, left) sets up equipment.



Over-all view of the firing range shows the relative position of the Little John equipment as it is unloaded from the 107.

Little John is launched, obscuring the Vertol 107 which is awaiting, with engines running, the signal to come in and pick up crew.



Sequence shows 107 redeploying crew and equipment. Elapsed time from landing of crew to redeployment is 11 min. 57 sec.

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Delays and high costs suffered in testing aircraft and missile navigational systems and components can now be reduced with Task's low threshold, high response Flight Simulators. Now, right in the laboratory, navigational systems and components and other rotation sensitive equipment can be subjected to real angular velocity and acceleration equivalent to that experienced during in-flight maneuvers.

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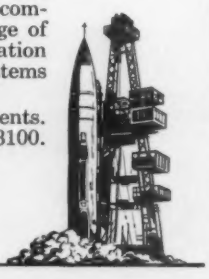
Special modifications to meet particular requirements. Complete details in Bulletin 591, or phone PR 4-3100.



TASK CORPORATION

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CJ-805-3 Thrust Rated at 11,200 Lb.

Cincinnati—Exact specifications for the General Electric CJ-805-3 turbojet engine show a thrust rating of 11,200 lb. and, with a guaranteed weight of 2,800 lb., a thrust-to-weight ratio of four to one. The engine powers Convair's 880 jet transport.

Thrust reverser and sound suppressor adds 390 lb. to engine weight, according to General Electric. Reverser provides 5,000 lb. of reverse thrust.

The engine has a maximum cruise thrust rating of 8,850 lb. with a specific fuel consumption of .728, General Electric says. Takeoff thrust is 11,200 lb. with an sfc. of .806.

Engine flight hours in various test programs total 5,094, according to General Electric. Sixteen engines have been used and high time engines have logged 1,111 hr. and 1,059 hr.

PRODUCTION BRIEFING

Clary Corp., San Gabriel, Calif., has developed a compact printer to withstand shock of 50g for printing output from instrumented data systems. The Class 2000 printer was originally designed to print information during countdown and checkout of Navy's Polaris missile. System is capable of accepting coded logical level output information in any of the standard forms, will print formats up to 21 characters wide and may be adapted to systems such as digital voltmeters, electronic counters, shaft position transducers, digital clocks, etc. Clary has orders for approximately $500,000 of digital recording equipment for Polaris, Atlas, Minuteman and Talos systems.

North American Aviation has awarded Horkey-Moore Associates a contract for development, production and testing of stabilization equipment for the air crew ballistic escape system for North American's B-70 bomber. System would enable B-70 crew escape-seat capsule to overcome airstream turbulence and prevent tumbling after ballistic ejection in case of emergencies.

Convair Astronautics Division recently broke ground for a captive test stand for Vega space vehicle at Sycamore Canyon near San Diego. Diversified Builders, Inc., will construct the $208,000 test stand which will utilize present Atlas blockhouse facilities and existing tunnels. Stand is scheduled for completion in February, 1960.

Britain's Farnborough air show next year will take place during the first full

week of September, starting Sept. 5. There had been some questioning in British aviation circles whether pace of aviation developments justified an annual display. However, it has been decided to go ahead next year in view of the satisfactory results of this year's Farnborough show, stated the council of the Society of British Aircraft Constructors.

Swissair has ordered mobile 60 kw. 400-cycle motor and diesel engine driven generators from Leach Corp. for ground support of its Douglas DC-8 transports at New York International Airport when transatlantic service is inaugurated in April, 1960. Units will furnish power for the DC-8s while loading and unloading and for checkout of instrument systems.

De Havilland Propellers will break into the industrial automation field with a new systems engineering group organized to draw on the company's experience with the Firestreak infrared homing system and Blue Streak ballistic missile. Group will emphasize design of integrated systems rather than components.

North American's Autonetics Division has received $4.7 million contract for production of additional inertial autonavigators for Polaris submarines from Navy Bureau of Ships. This brings Autonetics total orders from Ship Inertial Navigation System (SINS) to $15.2 million.

Hughes Aircraft's Airborne Systems Group has formed an Advanced Program Development team to improve customer liaison and introduce new products. Group will be responsible for tactical space, ballistic missile systems.

Summers Gyroscope Co. will deliver "free" gyros to the Martin Co.'s Orlando, Fla., Division for use in the Lacrosse missile. New orders, which exceed $1 million, call for deliveries through July, 1960. Orders increase Summers' backlog of business with Martin to almost $2 million. Total Summers backlog is more than $11 million.

Singer Manufacturing Co.'s Military Products Division will manufacture AN/ASR-3 submarine detecting sets under a $1 million Navy Bureau of Aeronautics contract. Work has already begun and will run until early 1961.

Telecomputing Corp. of Los Angeles will produce gyro systems for Nike Hercules surface-to-air missiles under $1,608,000 follow-on contracts from Western Electric Co.

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FLIGHT SYSTEMS RESEARCH

General problems in motivation and navigation in air and space; required background in astronomy, physics, engineering.

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Applicants should have at least a B.S. degree in Mechanical or Chemical Engineering, Metallurgy or Chemistry, and approximately 5 years' engineering experience in the design or materials-development phases of reactor technology.

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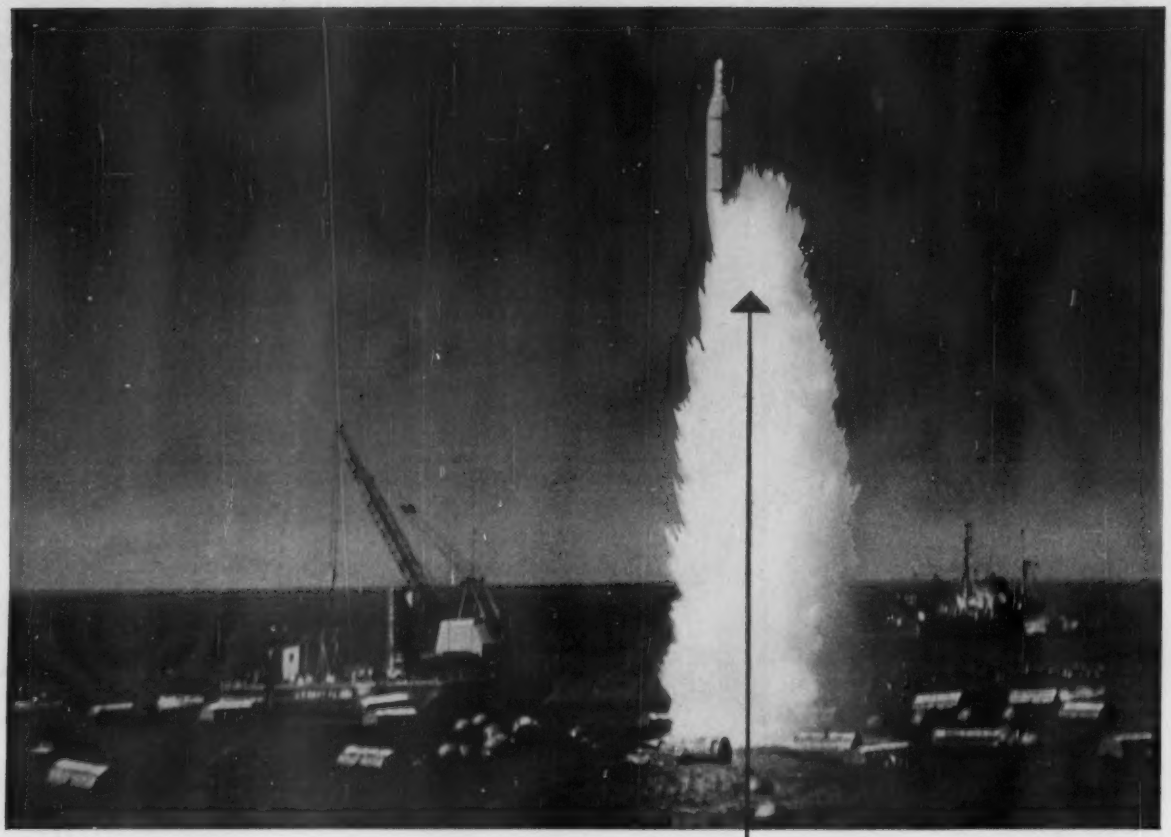

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To ensure launching and "in-flight" performance of one of our most important missiles, Barry was asked to study the problems of designing and building a test stand that would simulate the shock and vibration conditions to be met in actual flight.

Analysis, feasibility study, ⅓-scale model construction, and test were carried out at the Watertown facility.

RESULT — a servo-controlled mounting system that enabled the test stand to simulate launching and "in-flight" environments. Valid testing – increased reliability were made possible.

Design, development, test, and delivery of prototype system were completed in only five months!

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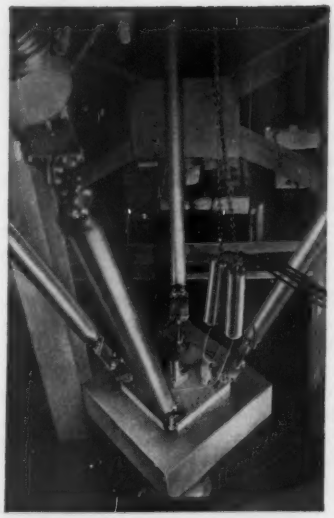

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FINANCIAL

Chance Vought Buys Data Processing Firm

Dallas—Chance Vought Aircraft has acquired a majority interest in National Data Processing Corp., Dallas, Tex., in its latest move to diversify into commercial applications. Move was forecast in a recent speech by Chance Vought President F. O. Detweiler, who noted the company was studying a second acquisition out of the aircraft field (AW Oct. 19, p. 34). More than a year ago it acquired Genesys Corp., Los Angeles, specializing in commercial electronics in computer applications.

Its latest purchase in the automation field manufactures the Readatron credit card system for processing retail credit invoices and is developing equipment to sort and process checks by means of magnetic ink character recognition for four federal reserve banks.

Same equipment is also sold to commercial banks.

National Data Processing Corp., formed in 1957, has 70 employes. It will continue to operate as an independent company in the data processing field. New parent company plans to invest in NDP expansion, including organization of a nation-wide sales and field engineering force.

British Engineer Guild Scores Low Salaries

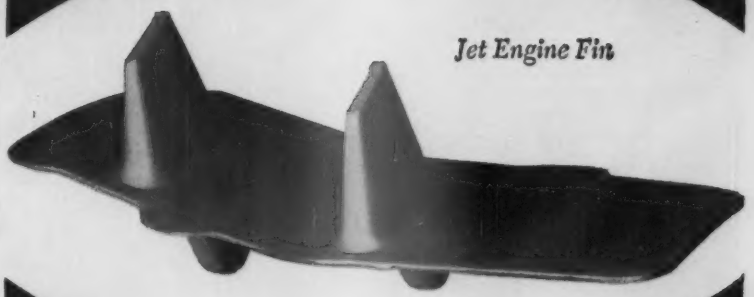
London—British Engineers' Guild—representing all categories of British engineers—has been moved by a survey on salary ratings to forecast a steady deterioration in the efficiency of industry unless something is done to boost earnings.

The survey, conducted by the government's Central Office of Information, showed that 50% of 6,000 members of the institutions of mechanical, civil and electrical engineers drew less than $3,360 during the 1955-56 financial year. Thirty per cent took home less than $2,800 and only one in four rated higher than $4,480.

Engineers' Guild admitted that real incomes since 1956 have improved but added that discrepancies shown in the survey between what was required and what was offered in way of actual salaries "are so great that there is still a very long way to go."

Real sting comes in the alleged impact of low salary scales on U. K. manufacturing industries' ability to recruit and retain staff. For a long time it's been a British complaint that technicians and scientists are lured to North

THE PART THAT "COULDN'T BE FORGED"



Jet Engine Fin

The jet engine fin shown above, is just one of many difficult configurations that Arcturus has forged after others said it couldn't be done. Originally these fins were machined from a forged rolled ring...a time-consuming, expensive procedure.

Using their highly-advanced techniques, Arcturus developed a method for forging the part, saving substantially on material and machining time...resulting in a cost reduction of 38%.

Chances are you are now buying machined parts that Arcturus could forge much more efficiently...saving substantially on material, weight, machining and total cost. High and low temperature alloys are our specialty. Why not send us those drawings and specifications right now?

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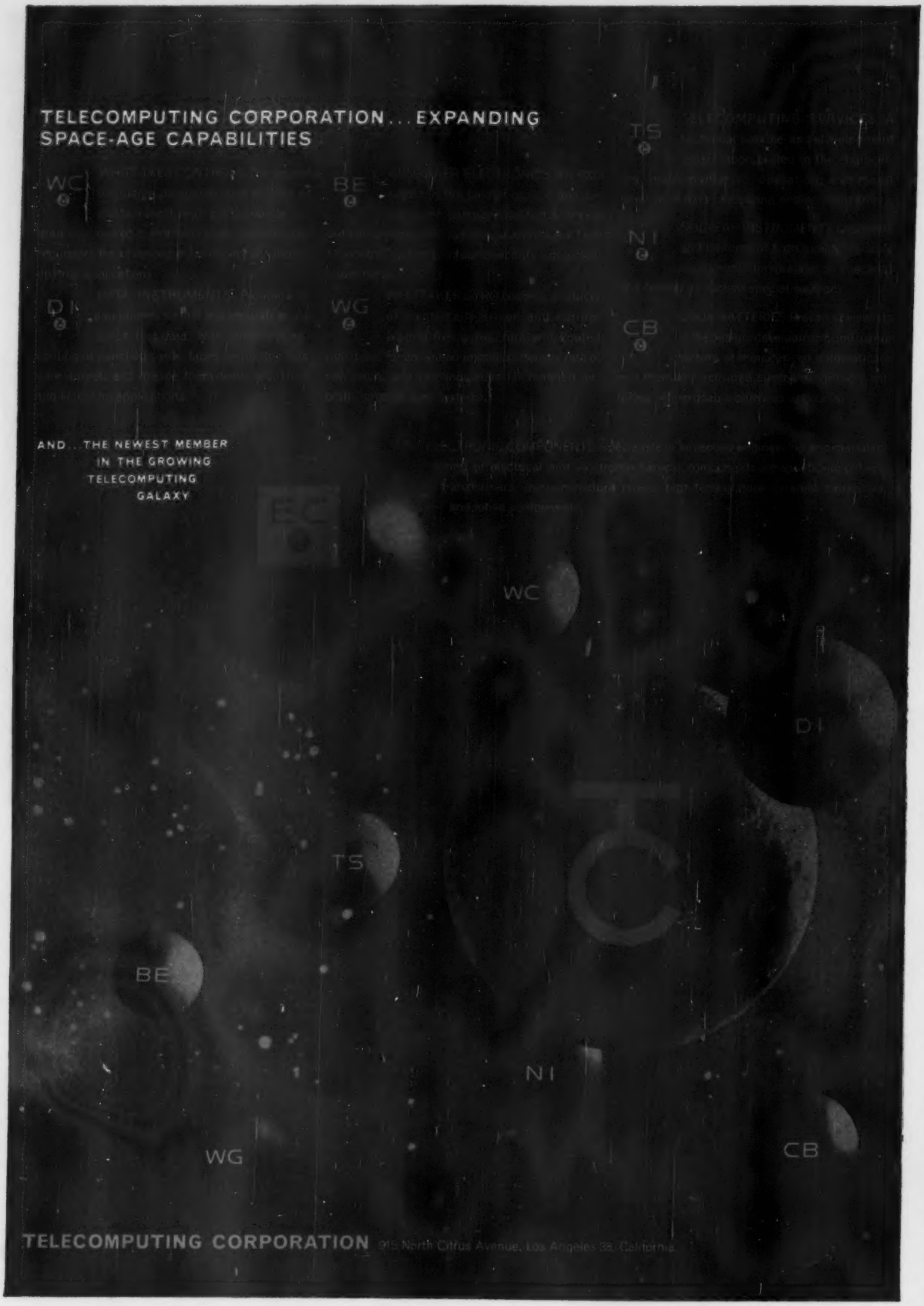
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America by high earnings obtainable there. Engineers' Guild emphasizes this point by stating that between 1954 and 1956 the emigration rate among members of the four leading engineering institutions was equal to just over 9% of their net increase in membership.

During 1955-56 period British engineers' earnings are contrasted with comparable U.S. figures of over $6,300 annually for 50% of the professionals at age 25, and $7,700 at age 30. Only one U.S. engineer in 10 was earning under $4,550 annually within one year of graduation, the Guild said.

Survey shows that engineers in the employ of local authorities and public utilities were the worst paid of all.

New Offerings

Eitel-McCullough, San Carlos, Calif., manufacturer of "Eimac" power tubes and electronic products. Offering is $5 million of convertible debentures for public sale; interest rate, offering price and underwriting terms to be supplied by amendment. Proceeds to be used primarily to retire current bank borrowings incurred to finance, in part, the company's expansion program and to provide additional working capital. Additions to the company's plant, machinery and equipment are expected to aggregate approximately $2,500,000 during 1959.

Missile Systems Corp., North Hollywood, Calif., sold 63,000 shares of common stock at $4.75 a share. Proceeds of approximately $259,000 will be used to retire $60,000 in bank loans, to purchase $50,000 in machinery and the balance for working capital to finance inventories and accounts receivable. The company may also allocate $120,000 for acquistion of other businesses. Missile Systems, formerly Ling Systems, Inc., a subsidiary of Ling-Altec Electronics until its purchase last April by Frederick W. Bailey, manufactures harness and cable assemblies, including umbilical cable for the Martin Titan ICBM, booster igniter cables for the Nike air-to-surface missile, and harness cable for use on the Convair F-106. As Ling Systems, Inc., the company engaged in complex microwave development efforts. On one Federal Aviation Ageny contract alone the company lost more than $200,000 and since its sale has dropped such programs.

Financial Briefs

Aerojet-General Corp. sales for the nine month period ending Aug. 31 were $257,809,573, a 72% increase over $149,359,992 sales for the same period last year. Earnings were $6,058,834 against last year's $3,709,345.

National Aeronautical Corp., producer of NARCO aviation products, reports sales of $4,735,000 for the nine month period ending Aug. 31, and after tax earnings of $528,000. Nine month's sales last year were $3,053,000 and after tax earnings $247,000. Company has just completed $400,000 plant expansion for development of new aviation products.

Craig Systems, Inc., reports earnings of $380,887 for the year ending July 31 on sales of $12,081,619, including earnings of Le Febure Corp., wholly-owned subsidiary. Earnings last year were $361,047 on $12,975,620 sales. Company produces systems for missile and communications installations; has an $11 million backlog.

Stanley Aviation Corp netted $86,026 on sales of $5,475,862 for year ended June 30. Last year's earnings were $163,924 on $4,618,161 sales. Profits this year were shaved by a $307,024 partial writeoff of a previous Stanley investment in Free Lock Corp., auto parts producer, made for diversification in 1957. Free Lock accounts were written down to realizable value.

Sanders Associates, Inc., producer of electronic guidance and control sys-

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tems recorded $326,754 net earnings for the year ending July 31, on sales of $10,659,304. This year's earnings were 40% higher than last year's, when the company recorded sales of $9,053,398.

Pacific Airmotive Corp. reports sales of $15,443,964, yielding after tax profits of $95,158 for the nine month period ending Aug. 31. Sales for the corresponding period last year were $15,157,586 for net after tax profits of $106,504. Company reports additional income of $1,093,739 from an upward price adjustment on military overhaul work done in past years, producing additional after tax profits for the period of $460,000.

Fairey Co., formerly Fairey Aviation, reported net profits fell by almost $2½ million to $320,488 in the year ended Mar. 31. Research and development costs rose $1.7 million, causing part of the drop. Dividend remains at 15% but future policy is uncertain.

World Wide Helicopters, feeling the revenue lost by crashes of a Sikorsky S-58 and a Westland-Sikorsky helicopter, reported net income for the first half fell to $70,415 or 6 cents a share compared with $247,585 or 26 cents a share last year. Gross revenues for the period were $1,193,279.

Acquisitions And Mergers

Fairchild Camera and Instrument Corp., Syosset, N. Y., will ask stockholders, Nov. 30, to approve purchase of R. C. Allen Business Machines, Inc., Grand Rapids, Mich., and to split Fairchild's stock two for one. Earlier Fairchild Camera had exercised its option to buy all the common stock of the Fairchild Semiconductor Corp., formerly an affiliated company. To acquire the Allen company, which makes aircraft instruments as well as business machines, Fairchild will issue 60,000 shares of its split stock in exchange for 300,000 shares of Allen stock now outstanding.

U. S. Industries, Inc., has acquired Burtonwood Engineering Co., Ltd., Lancashire, England, a manufacturer of industrial products grossing approximately $5 million annually. U. S. Industries turns out a variety of industrial equipment, in addition to electronic, aircraft and missile products.

Swedlow, Inc., producer of honeycomb, plastic window glazing and other aviation materials, has acquired a financial interest in the recently formed TE Co., Santa Barbara, Calif.

BENDIX SR RACK AND PANEL CONNECTOR

with outstanding resistance to vibration

The Bendix type SR rack and panel electrical connector provides exceptional resistance to vibration. The low engagement force gives it a decided advantage over existing connectors of this type.

Adding to the efficiency of this rack and panel connector is the performance-proven Bendix "clip-type" closed entry socket. Insert patterns are available to mate with existing equipment in the field.

Available in general duty, pressurized or potted types, each with temperature range of −67°F to +257°F.

Here, indeed, is another outstanding Bendix product that should be your first choice in rack and panel connectors.

FEATURES:

Resilient Insert • Solid Shell Construction • Low Engagement Forces • Closed Entry Sockets • Positive Contact Alignment Contacts—heavily gold plated Cadmium Plate—clear Irridite finish • Easily Pressurized to latest Mil. Specifications.

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WHO'S WHERE

(*Continued from page 25*)

Changes

A. D. Sands, new products development coordinator, Defense Contracts Organization, Burroughs Corp., Detroit, Mich.

Ervin L. Penkalski, director of the AC Spark Plug Facility at the Douglas Aircraft Co., Santa Monica, Calif. Mr. Penkalski succeeds **Jack Henry** who has returned to the Milwaukee Operations in charge of maintenance engineering-Thor project.

Richard W. Powell, manager of Aerojet-General Corp.'s Avionics Division, Azusa.

Theodore E. Dinsmoor, deputy director, Research and Development Division, American Machine & Foundry Co., New York.

Kenneth M. Smith, director of military relations-future product areas, Convair Division of General Dynamics Corp., San Diego, Calif. **Lawrence E. Spear** succeeds Mr. Smith as manager of long range planning, Convair's Pomona, Calif., plant. Also: **Karl S. Warren,** assistant to the vice president, with responsibility for missiles and electronics; **William C. Keller,** assistant to the vice president, with responsibility for aircraft.

Rear Adm. Carl F. Stillman (USN, ret.), manager of government contracts and assistant to the president, Radiation Research Corp., New York, N. Y.

R. H. Wettach, manager of the newly established organization for the manufacture of solid rocket cases, General Electric's Rocket Engine Section, Evendale, Ohio.

Stephen J. Jatras, director of engineering, Lockheed Electronics and Avionics Division, Los Angeles, Calif.

Dr. Eric Durand, manager of the newly established Boston, Mass., facility of the Range Systems Operations of Aeronutronic, a division of Ford Motor Co. The facility has been established for advanced research and development work in space sciences, astrodynamics and range instrumentation.

Larry Adams, contracts manager, Hydro-Aire Co., Burbank, Calif.

American Bosch Arma Corp., Hempstead, N. Y., has appointed **Stanley L. Haines** site manager of the Arma Division's Cape Canaveral Field Operation.

Dr. John P. Curtis, group leader-antenna and special systems group, Hermes Electronics Co., Cambridge, Mass.

Harry A. Ferullo, weapon systems manager, Missiles and Space Systems Division, United Aircraft Corp., East Hartford, Conn.

Richard G. Bowman, technical assistant to the president, and **Carver T. Bussey,** special assistant to the president, Republic Aviation Corp., Farmingdale, N. Y. Also: **Dr. Samuel Lubkin,** staff consultant to the Missile Systems Division.

Frederick C. Rueckert, manager of corporate development, Chicago Aerial Industries, Inc., Melrose Park, Ill.

Arthur A. Hauser, Jr., director of technical planning, and **John J. Rutherford,** director of long range planning, Sperry Gyroscope Co., Division of Sperry Rand Corp., Great Neck, N. Y.

Jack Baxby, project manager-research and development contracts, McCormick Selph Associates, Hollister, Calif.

MINIATURE PRESSURE SWITCH HARNESSES PRESSURES TO 4500 PSI

For air, oil or hydraulic service, this miniature pressure switch performs like a veteran. Fabricated of stainless steel, it weighs less than two ounces, yet will withstand pressures up to 4500 psi. With no rubber parts, cure-date replacements are eliminated.

The MA-40 is one of a group of Aerotec components that have been radically redesigned and miniaturized to meet the exacting weight, size and operating requirements of modern aircraft and missiles.

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Proof pressure	4500 psig
Temperature range	−100°F to +500°F

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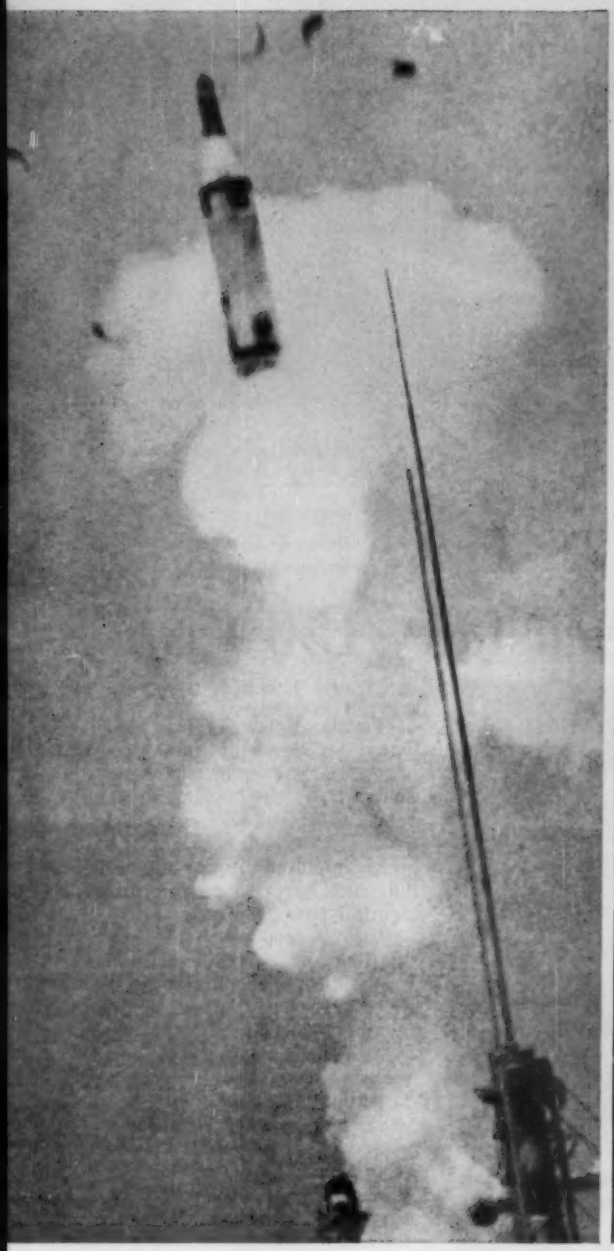
AIRCRAFT EQUIPMENT DIVISION, DEPT. W, GREENWICH, CONN.
CANADIAN AFFILIATE: T. C. CHOWN LIMITED, MONTREAL

The Log of the Navy's Polaris

1958 In January, just a year after the Navy had announced its plans for a Fleet Ballistic Missile, the first Polaris test vehicle was successfully fired. Firings continued throughout 1958. By September the test vehicles were close to the final configuration of the Polaris.



1959 Operations Skycatch and Peashooter tested methods for ejecting the Polaris... Operations Pop-up and Fishhook tested a submerged launcher. In August, a Polaris test vehicle was launched from the deck of the USS Observation Island.

1960 The Polaris is scheduled for active duty in late 1960. Each of the Navy's nuclear subs will carry 16. Lockheed is prime contractor and missile system manager of a team that includes Aerojet-General, General Electric, and Westinghouse.

LOCKHEED

MISSILES AND SPACE DIVISION

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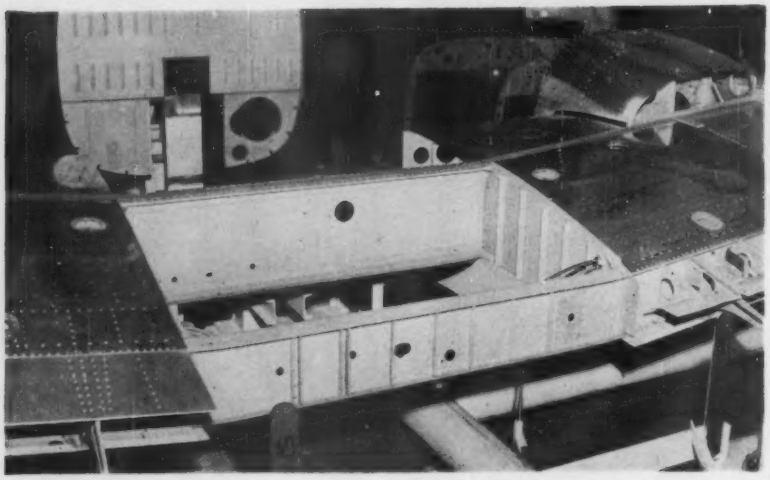
RAMJET PROPULSION TESTING

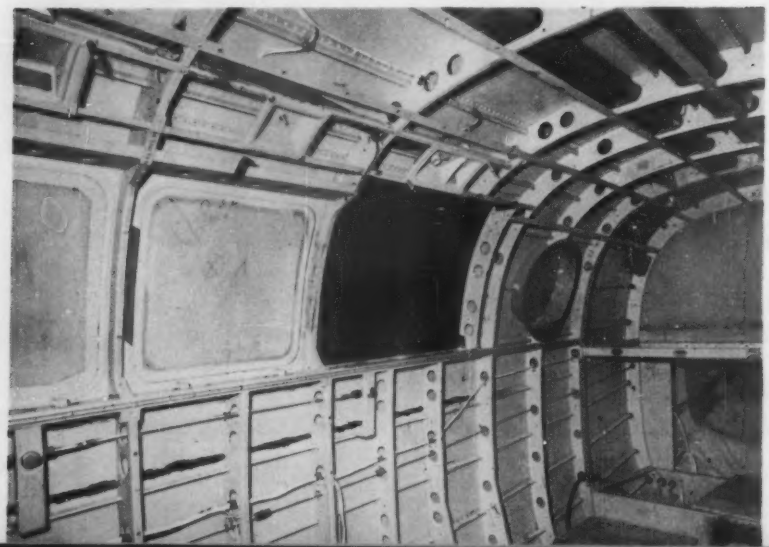
GEAR EXTENSION cycle of Beech 65 nears completion in flight. Wheels can be lowered while airborne to slow the airplane during turbulence or to steepen approach at speeds to 150 mph. under normal conditions, or up to 220 mph. under emergency conditions.

Beech 65 Market Forecast at $150 Million

By Erwin J. Bulban



CENTER SECTION of Beech Queen Air incorporates deep main and rear spars. Window arrangement (below) combines picture window effect with structural integrity.



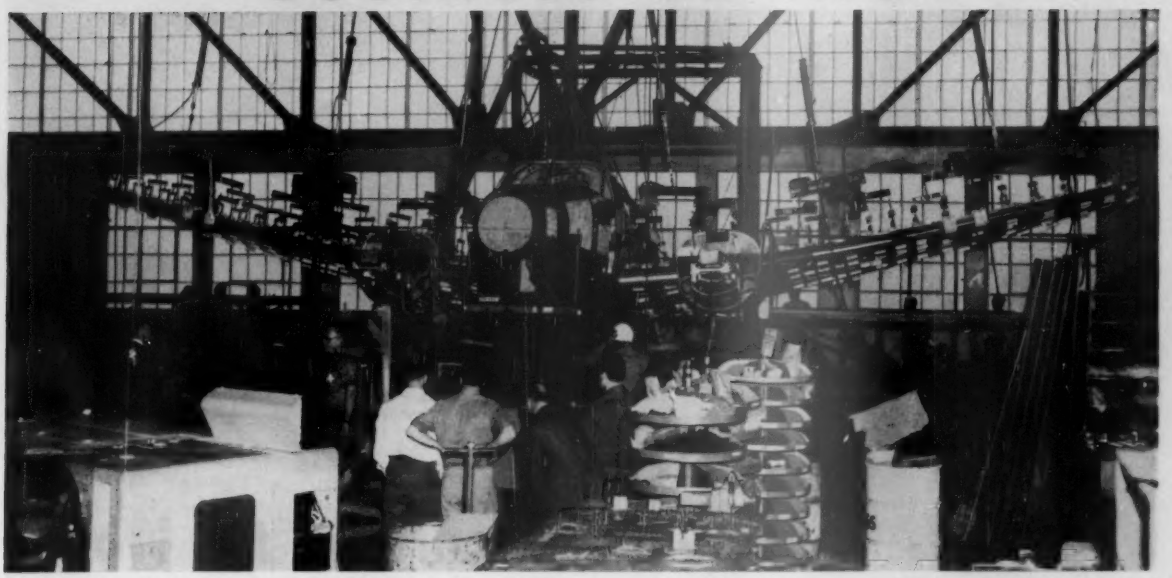
Wichita, Kan.—Six-place Beech 65 Queen Air represents culmination of a design exercise utilizing major components of the company's smaller Model G-50 Twin-Bonanza to create a new class of business airplane with greatly improved capacity and negligible differences in performance using the identical powerplants.

With Federal Aviation Agency certification of the airplane accomplished, it remains to be seen how successful the Beech sales team will be in following up the engineering effort. Indications are that the sales group is confident that the airplane will more than pay its way. According to Leddy Greever, Beech vice president-commercial sales, the new airplane will account for a dollar volume of approximately $150 million in its anticipated 10-years useful sales life, a figure that has been raised considerably from early estimates of $100 million on this aircraft. This would mean unit sales of 800-1,200.

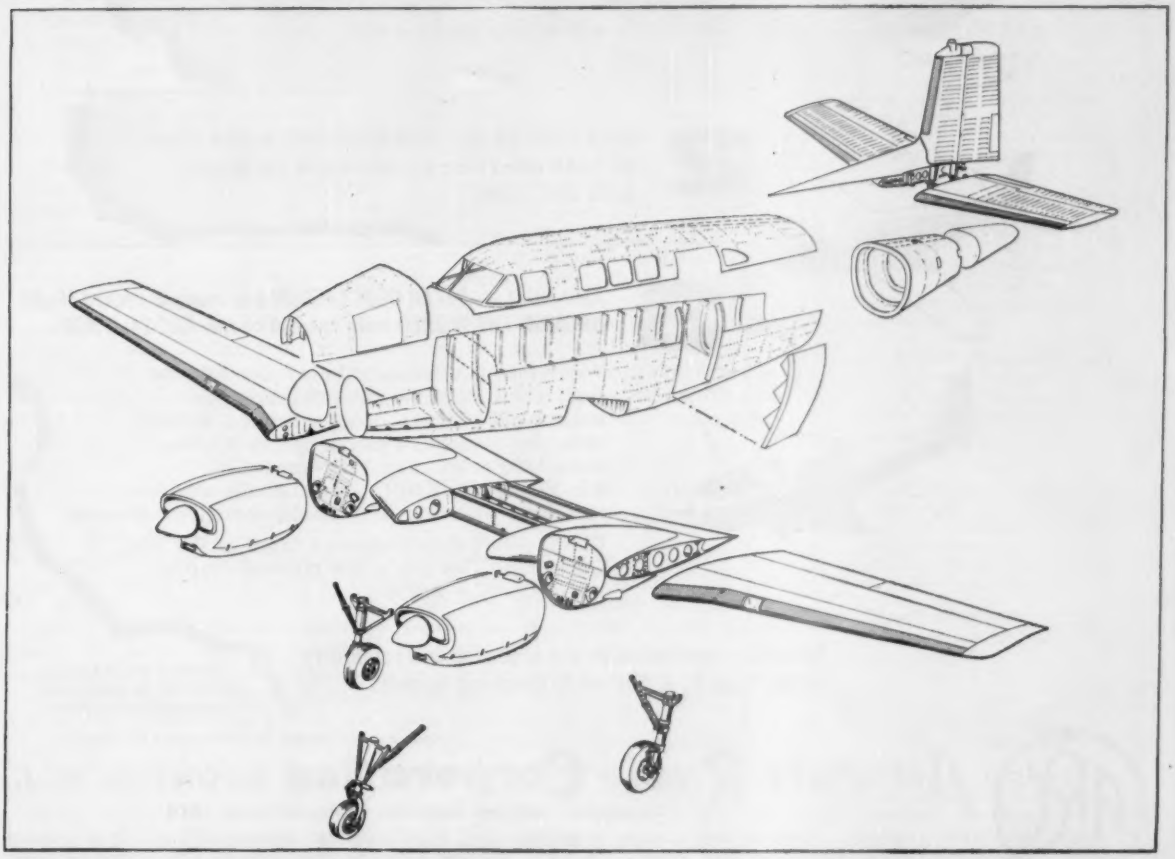
Sales Appeal

The airplane was introduced at the National Business Aircraft Assn.'s recent annual forum in Minneapolis, Minn. (AW Oct. 12, p. 37). After the meeting was over, a local Beech distributor at at whose base the airplane had been stationed for flight demonstrations, told AVIATION WEEK that he was sure he could have sold five Queen Airs had they been there ready for flyaway.

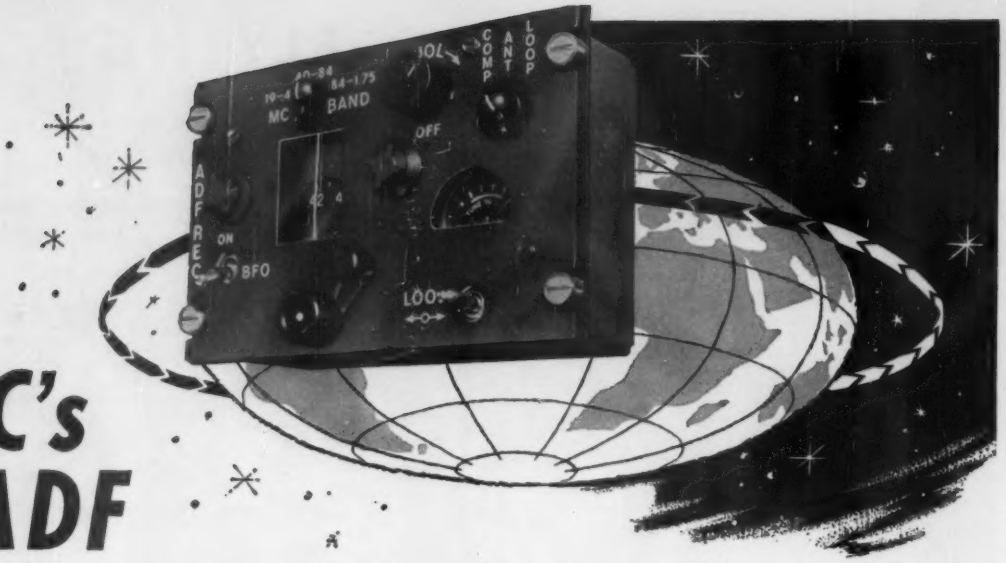
A basic reason for anticipated heavy volume and a decade at least of useful sales life is the stretch put into the configuration by Model 65 Chief Pro-



BEECH 65 in static test is shown with wingtips flexed upward 26 in. from zero position during course of Federal Aviation Agency load factor requirement trials. FAA load factor requirement for the airplane is 3.48; Beech designed Model 65 to a load factor of 4.4 and its static test represented 115% of ultimate loading based on a factor of 4.4. Test actually was more severe than anticipated because several times whiffle tree loading fixture snapped, causing wings to flex and placing heavier stresses on structure than required.



EXPLODED VIEW shows major assemblies. Construction and layout are much the same as in Model G-50 Twin-Bonanza except for detail changes to accommodate Model 65's new fuselage.



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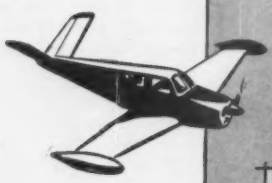
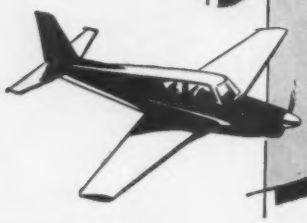


1 ***CAPT. "PAT" BOLING DID IT IN 1958 with a light plane record flight of 6,856.32 miles from Manila to Seattle with ARC's Type 21-A ADF.***



2 ***MAX CONRAD DID IT IN JUNE, 1959 with a flight of 7,668 miles from Casablanca to Los Angeles with ARC's ADF.***

3 ***AND NOW — PETER GLUCKMANN has made a record flight AROUND THE WORLD with the aid of the ARC 21-A ADF.***

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Beech 65 Queen Air Specifications

Wing span	45 ft. 10.5 in.
Wing chord (root)	84.61 in.
Wing chord (tip)	42 in.
Mean aerodynamic chord	77.86 in.
Airfoil (root)	NASA 23014.1 mod.
Airfoil (tip)	NASA 23012 mod.
Incidence (root)	4.8 deg.
Incidence (construction tip)	0 deg.
Dihedral	7 deg.
Aspect ratio	7.51
Wing area (total)	279.74 sq. ft.
Wing group empty weight	692 lb.
Fuselage length	33 ft. 4 in.
Fuselage ground angle	1 deg. 20 min.
Door width	27 in.
Fuselage group empty weight	601 lb.
Horizontal tail span	205.46 in.
Root chord	66.2 in.
Tip chord	42.13 in.
Airfoil section (root)	NASA 0012 mod.
Airfoil section (tip)	NASA 0016 mod.
Normal incidence	1 deg.
Dihedral	7 deg.
Aspect ratio	4.15
Vertical tail maximum height	14.2 in.
Airfoil (root)	NASA 0012 mod.
Airfoil (tip)	NASA 0009 mod.
Aspect ratio	1.28
Tail group empty weight	153 lb.
Aircraft empty weight	4,740 lb.
Total useful load	2,960 lb.
Design gross weight	7,700 lb.
Basic landing design gross weight	7,350 lb.

ject Engineer R. P. Aylward's design team. Beyond the immediate utility of the new Queen Air, these additions are provided in the original structure for incorporation without major modification:

• **Pressurization capability,** with design providing for differentials of from 2 to 2.5 psi. being anticipated. Shape of the fuselage is partially based on adding pressurization without need for changing contours. Current production airplanes are made without permitting any weight penalties for future pressurization to be incorporated now. Sources close to the company indicate that pressure tests on specimen fuselage sections already have been run.

• **Turboprop engine** installation is another development that lies ahead for the airplane. Chances are that this feature is still down the road—possibly another five or six years and that pressurization will precede it to provide maximum benefits of altitude performance in the interim period. The airplane's sales capability thus would not be compromised by taking two new and costly features on simultaneously.

What engines are Beech engineers looking at now? "We are looking at them all," they told AVIATION WEEK here at the plant recently, "but what we are now thinking of the hardest is what they will cost. We think now that the engine we will use will have to cost somewhere in the neighborhood of $20 per shaft horsepower to keep powerplant cost in practical relation to the rest of the airframe cost." This would appear to rule out Canadian Pratt & Whitney Aircraft's new PT-6A 500-eshp. (takeoff) turbine, which is being estimated at $30 per shp. but of course, production quantities, availability, reliability and other factors present several years from now could make it a contender.

Indications are that one solution might be to utilize the twinned version of the low-cost Allison T63, which would produce 500 shp. in this configuration and provide a safety factor in its ability to operate with one unit shut down, giving in effect a four-engine installation in two small packages. Prices being quoted would be near Beech thinking today. Another contender is the Boeing T60-BO-2 turbine (AW July 20, p. 97).

Chances are that both pressurization and turbine stages would be preceded by a more conventional improvement —use of a new more powerful flat Lycoming piston engine now in development.

One reason Beech engineers are so confident of the Model 65's capability

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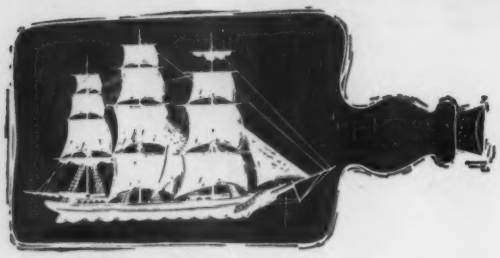

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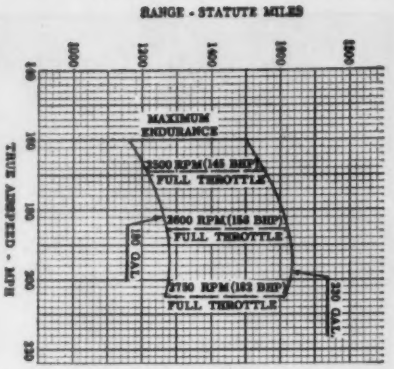
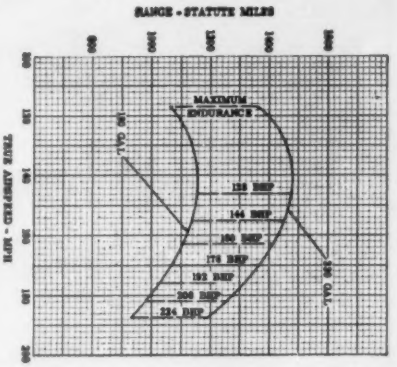

RANGE - STATUTE MILES
MAXIMUM ENDURANCE
2500 RPM (145 BHP) FULL THROTTLE
2600 RPM (156 BHP) FULL THROTTLE
2750 RPM (182 BHP) FULL THROTTLE
30 GAL.
30 GAL.

RANGE at 20,000 ft., standard altitude, no wind, no reserve, 7,700 lb.



RANGE at sea level, no wind, no reserve, 7,700 lb.

is that they have had the number one prototype—and current demonstrator—flying since August, 1958, accumulating approximately 300 hr., and three others working with the U. S. Army (L-23F) which have amassed 1,300 hr. flying hours here and abroad, another now being evaluated by the Japanese Civil Aviation Board, plus another airplane now being refitted for delivery to the Federal Aviation Agency. All told, the basic airplane has well over 2,000 hr. total time on six airframes prior to the first production model under a variety of operating conditions and has accumulated a good maintenance record, the company reports.

In laying out the Model 65, Beech engineers were concerned with utilizing all components of the Twin-Bonanza possible without modification, except for design of the completely new fuselage which would provide a true cabin-type business plane with side entrance airstair type door and provision for isolating the crew from passengers. Problem was to achieve comparable performance in spite of an increase in gross weight (7,700 lb. as against the G-50's current 7,150 lb.) using the same 340-hp. geared and supercharged fuel injection Lycoming IGSO-480-A1A6 engines. Model 65's useful load is 253 lb. better than the G-50, and stall-

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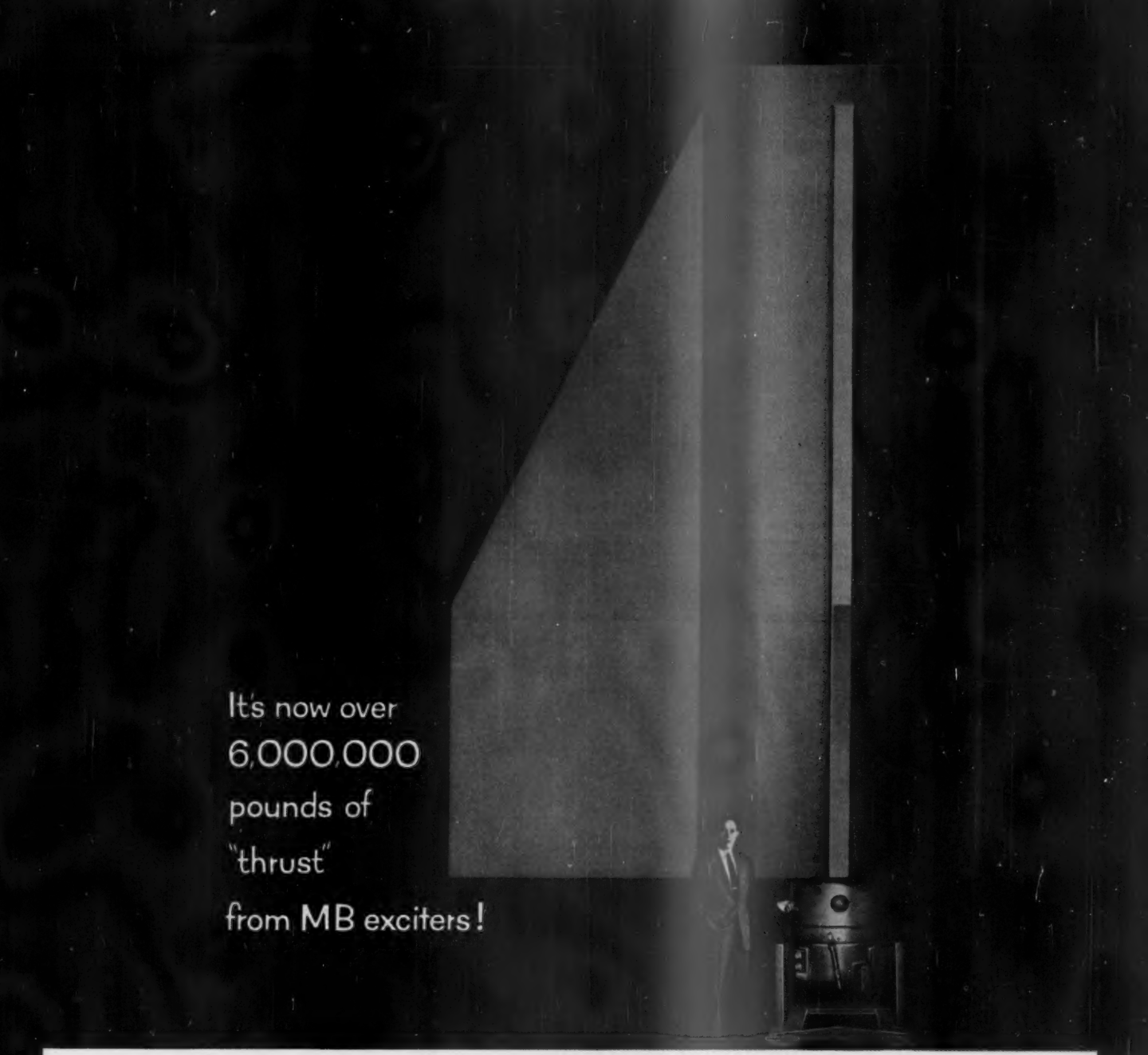

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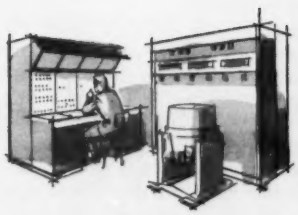

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RAYTHEON MISSILE SYSTEMS DIVISION

ing speed is lower, Beech notes.

Solution they developed was simply careful attention to lofting the fuselage lines to provide minimum drag, careful addition of fillets to wing-body connections, revision of engine nacelles to provide smoothest air flow—even placing the door in a position where possible air leaks would have the minimum effect in disturbing flow over the wing-body combination. A high fineness ratio nose and carefully developed windshield slope also made important contributions to drag reduction. Cabin air conditioning intakes and exhaust outlets were plotted to provide smooth flow with low drag. Structural joints and service openings were carefully sealed to minimize air leakage.

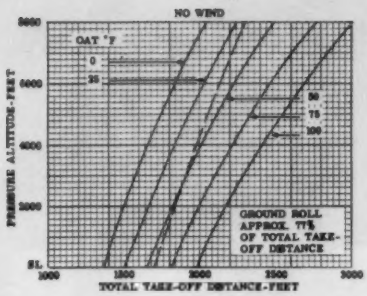
For improved aerodynamic cleaness all fuselage skin rivets ahead of Station 84 are flush if machine driven and universal head if hand driven, with all hand driven rivets on the nose forward fuselage using machine countersinking rather than dimpling where possible. To avoid dimpling skins, rivet sizes are decreased and number of rivets increased.

Low Noise Level

This attention to aerodynamic cleanliness paid an additional bonus in sharp reduction of cockpit and cabin noise level—and those who have flown in the airplane in either or both these positions note that the interior quietness of the Model 65 is one of the airplane's outstanding flight characteristics. On a flight to Wichita from Minneapolis, Queen Air sales manager Marvin Small noted that precise angling of the windshield to provide minimum drag was also found to provide a decided decrease in cockpit noise level.

In a step to reduce cabin interior noise levels, Beech carefully guided conditioning air through large ducts in the roof of the airplane and exhausted it behind the cabin. Air inlets for individual passenger comfort are also positioned to provide minimum whistling. Where acoustical tests showed that fuselage skin panels would tend to develop low-frequency vibrations, they were sprayed with a sound deadening material to increase their mass and resistance to flutter.

Structurally, the fuselage is of conventional semi-monocoque construction with skins, rolled J-section stringers, bulkhead frames and webs, and formed sections of Alclad 2024ST alloy. Build-up consists of the nose section, cabin top, cabin belly and tail cone. Cabin top, window and cabin door frame members are similar in structure to that used in the Model E18S Twin Beech, being a composite of simple formed pieces rather than the drop hammer die-formed hat section parts used on the Model G-50 Twin-Bonanza. Nose cone,



NORMAL takeoff distance over 50 ft. at 95 mph. indicated airspeed, zero flaps, gross weight 7,700 lb.

designed for installation of an RCA AVQ-50 lightweight weather radar antenna, is of low-pressure glass cloth laminate as is the tail cone.

Nose compartment has a door similar to that on the G-50 on each side to facilitate easy access to radio and navigation boxes—forward equipment compartment having a structural capacity of 350 lb.

Air conditioning system includes a Janitrol heater of approximately 100,000 Btu. per hour and provides two complete changes of cabin air per minute. Heater ducts are run under the floor on the right side of the fuselage, taking warmth to the rear of the cabin where the flow is reversed and pumped forward. Studies indicate that this system provides even heating of the entire cabin since normal cabin air flow tends to move forward. Control lines are all run along the left side of the fuselage, leaving center floor free in event the airplane is to be used for aerial photography or other applications requiring equipment installation in the belly.

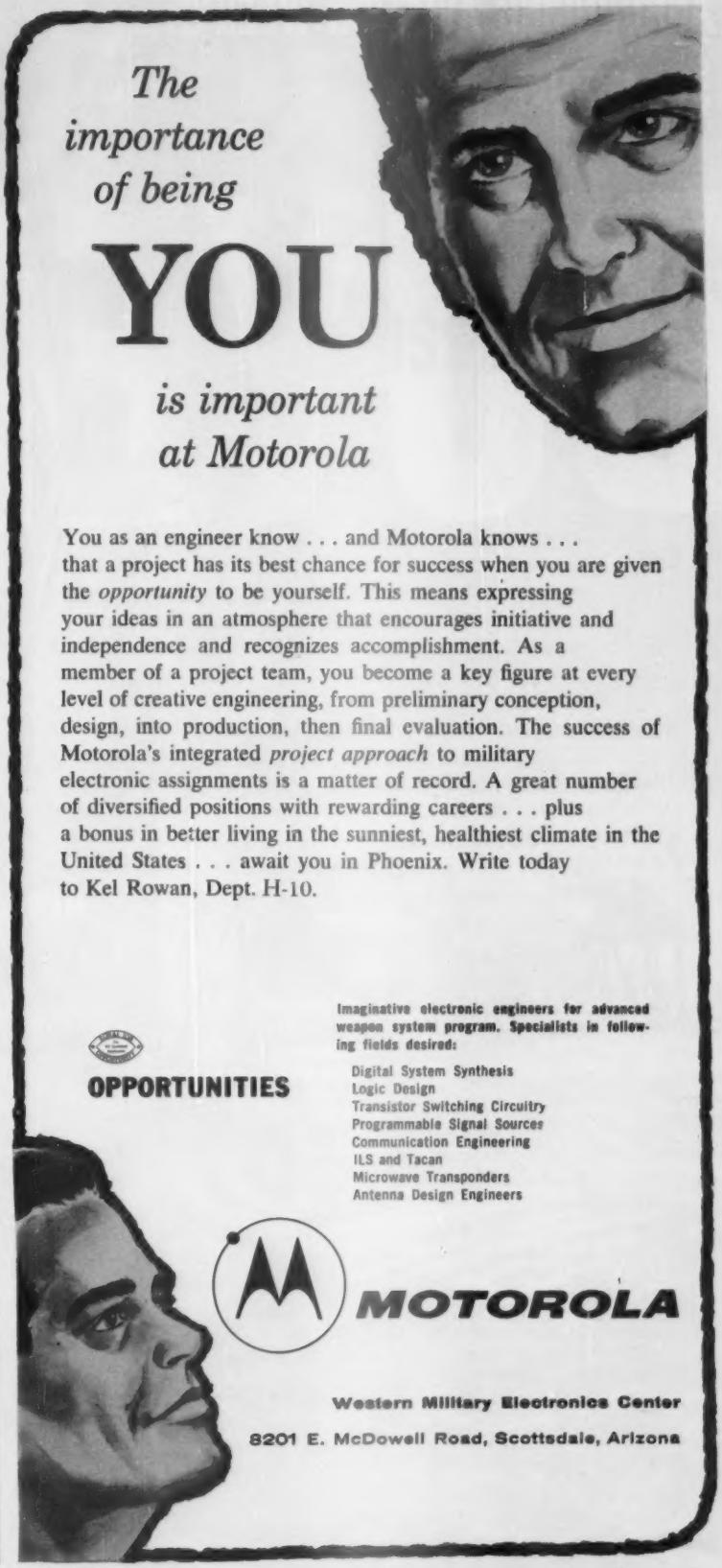
Cabin Windows

Cabin windows are placed together, separated only by frames, to provide "picture-window" visibility without sacrificing structural integrity and size. Placement noticeably provides an impression of cabin airiness and spaciousness.

Rear window on the right side is also an escape hatch for emergencies. Seats are adjustable and track-mounted to permit placement providing maximum legroom for passengers.

Standard version has four facing seats, two on each side of a sunken aisle, with folding tables between seats. A high-density model, with reduction of fuel or baggage, would have three seats on the right side, eliminating the buffet normally located behind the rear seat, or a three-place couch could also be placed on the right side. Lavatory is located in the rear of the airplane and can be separated for privacy by a sliding curtain.

Pilot's compartment, separated by a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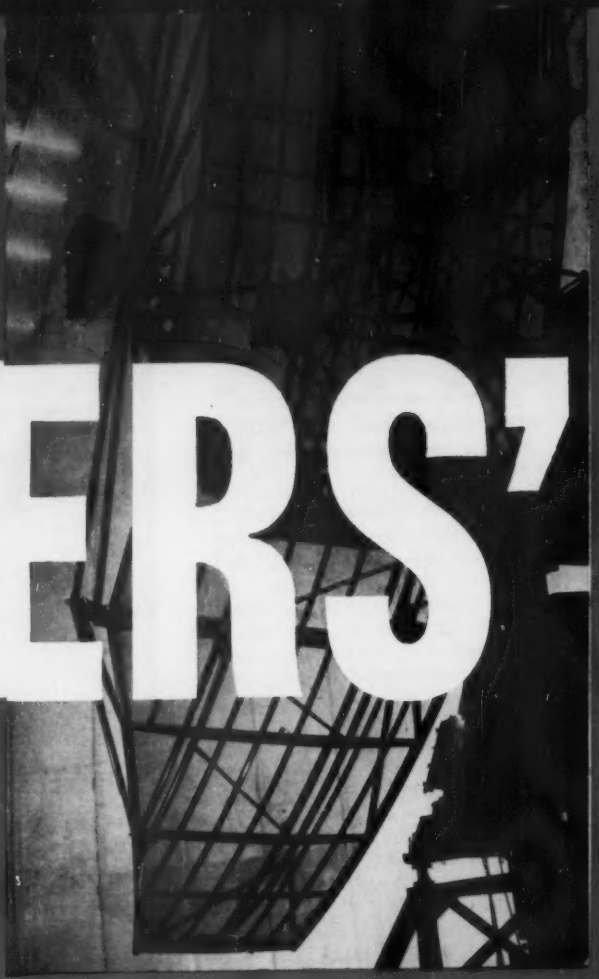

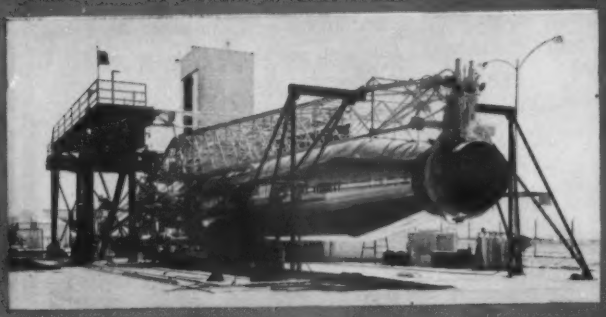

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Be sure to reserve space in this exclusive issue . . . publishing date is mid-December and closing date is November 1, 1959.

BUYERS' GUIDE ISSUE FOR 1960

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Aviation Week
Including Space Technology

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AC SPARK PLUG ❀ THE ELECTRONICS DIVISION OF GENERAL MOTORS

pair of sliding doors, appears to be more spacious even than the larger Beech E18S Twin Beech, although some improvements in this area are indicated for 1960 models of that airplane. Low vibration level is noticeable in this area by leaning one's elbow on the side window inner frame. This position can be maintained as long as desired without irritation.

Wings are identical in structure to the Model G-50 Twin-Bonanza, except for revised tips to reduce tip vortices and lessen drag. Wing incidence is reduced one degree from that of Model G-50. Center section, which extends from just outboard the engine nacelles is similar to that of the G-50 except for changes necessary to adapt it to the Model 65's new fuselage and that the inboard upper and lower skins, the sub spar and rear spare are beefed up to take the increased gross weight of the airplane. Ailerons and flaps are identical to the G-50, and systems and actuators are identical except for revision of locations and some increase in linkage parts where needed.

Entire tail group is identical to that of the Model G-50 except for modification of the dorsal fin and lengthening the torque tube at the root of the elevator. Dorsal fin is of identical construction to the G-50, but is actually smaller in area and more smoothly faired to the fuselage, the G-50's rubber gap strip being eliminated.

Deicing System

Wing and tail deicing system will be of new Goodrich lightweight type, using Model G-50 parts except as affected by the new fuselage. Considered in future installation is a new Goodrich electric system for propeller anti-icing.

Landing gear is identical to the G-50's except that tires are increased one ply and strut material by one gage. These changes are also being made in production G-50s. Nose gear strut is moved 2.5 in. forward, increasing the Model 65's wheel base. Retraction system parts are retained except for some modification in a few components to accommodate the longer wheel base and new fuselage. Flight control systems are also the same as the G-50's—even to the rudder pedals. Only change is that sense of direction of the aileron and rudder tab controls have been changed to coordinate sense of direction to aircraft response.

It is obvious that the considerable retention of Model G-50 Twin-Bonanza parts and systems will not only help keep the price of the airplane down considerably from what it would have been if a completely new aircraft had been designed, but should also make the spares problem easier to handle and more economical and pose few new problems for maintenance personnel.

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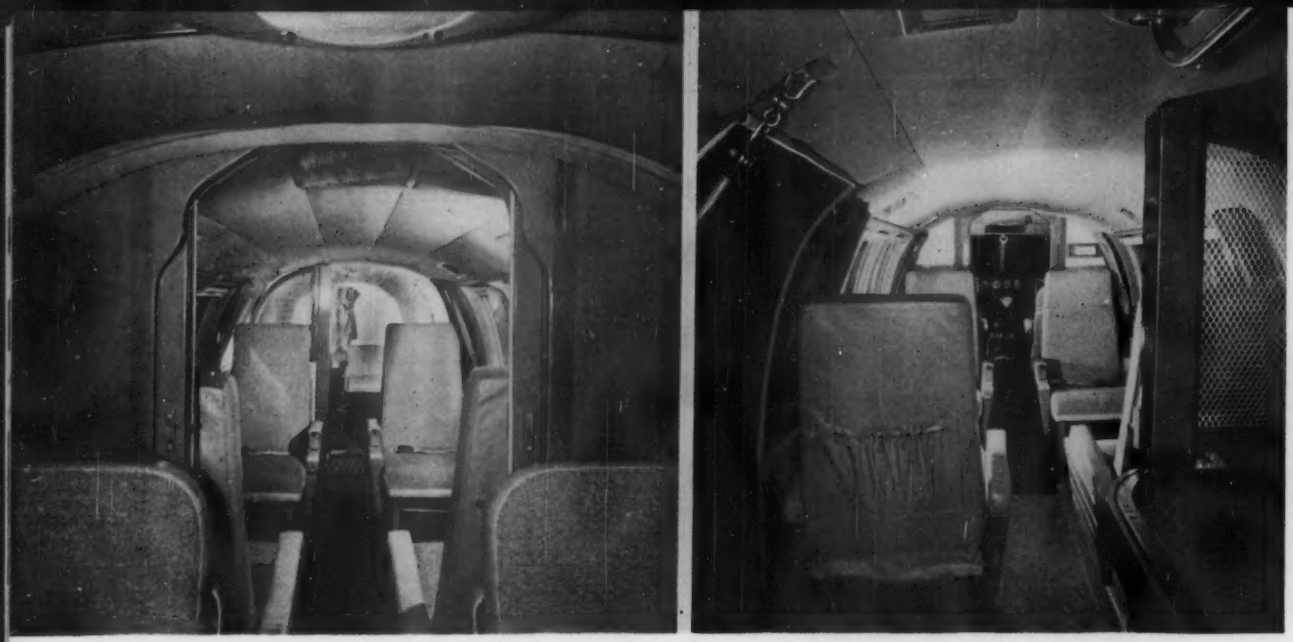


PILOT seats are in foreground (left) in this view of Model 65 interior; view at right shows portion of baggage compartment.

Aviation Week Pilot Report:

Low Noise Level Marks Beech 65 Flight

By Herbert J. Coleman

Minneapolis—Low noise level is a pronounced flight characteristic of the Beech Model 65, flown here by AVIATION WEEK during the National Business Aircraft Assn. annual meeting.

The 1 hr. and 20 min. flight was made entirely in instrument flight rule conditions that prevented a complete exploration of the airplane's handling qualities.

Though the first production aircraft to be delivered next spring will have a basic price of $120,000, the demonstrator N110Q flown by AVIATION WEEK would sell for approximately $170,000 with all the equipment it carried. Beech will build 53 Model 65s next year—10 of these for export.

QUEEN AIR center aisle is recessed for headroom; note heater outlet near adjustable seat floor runners.

On climbout from Wold-Chamberlain Field here, conversation was practically at room level and an overhead loud speaker for tower and radar control transmissions was used exclusively. Head sets, although available, were not worn.

Judged on the basis of the somewhat unrepresentative flight, the airplane demonstrated quick responsiveness to control action and no unstable tendencies.

It is a pilot's airplane both from the handling and comfort views. No stalls or single engine operations were attempted, due to adverse weather conditions, but Joe Achten, Beech pilot in command, said there is no abrupt payoff and the plane gives ample warning.

The airplane is powered by two 340 hp. Lycoming supercharged IGSO-480-A1A6 horizontally opposed engines, equipped with Simmonds fuel injection systems. Propellers are three-bladed, constant speed Hartzells, including provisions for full-feathering.

Beech says that with 65% power, range would be about 1,030 mi. with a 45 min. fuel reserve (carrying six occupants and 150 lb. of baggage). Endurance at that flight regime would be about 5 hr. 15 min.

Engines started quickly; system involves a direct crank and electric prime. Temperatures and pressures operated normally and we taxiied out. Nose wheel is steerable by rudder pedals. Ground engine check is easily accomplished: propellers are run through to check feathering and put hot oil into the domes; check of magnetos is made at 2,500 rpm., with a 150 drop allowable. Trim tabs are centered. Takeoff was made at 35 in. Hg. and 3,400 rpm.

Airplane was off the ground in 20 sec., longer than usual because of the IFR conditions. Climbout was made at 150 mph., which produced a 900 fpm. climb rate, again lower than usual because of weather. After topping the overcast at 5,000 ft., power was reduced to 65%, using 34 in. and 2,600 rpm.

Airspeed at this power was 180 mph., for a true airspeed of 192 mph.

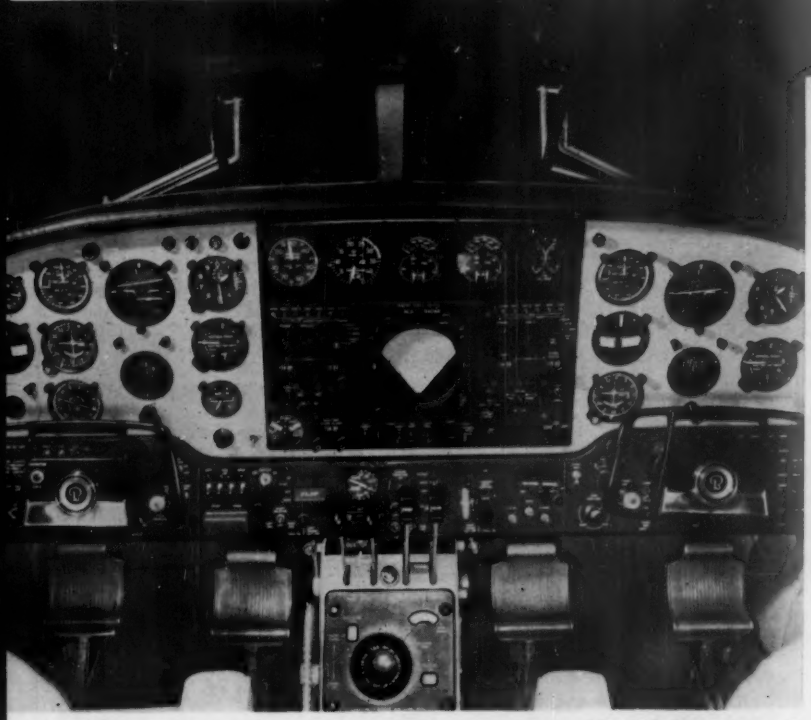
Altitude Change

Because of a required altitude change to 6,000 ft., we went back to cruise climb power of 38 in. and 3,000 rpm.; cylinder head temperatures held steady at 310 deg. and oil temperatures at 172 deg.

Aircraft is instrumented for all-weather operations, with exception of wing deicer boots; propeller and windshield are deiced from a 3-gal. tank. N110Q was equipped with dual omni and an ARC communications package for full VHF operations; this included two VHF transmitters and one VHF receiver. Navigation facilities include instrument landing system glide slope receiver and indicator.

Radar available for this airplane is RCA AVQ-50 model weather surveillance type, which was not operative for the Minneapolis flight. Radar and communications package is optional equipment.

Letdown for return to the Minneapo-



ENGINE instruments, radio-navigation controls are at center of Model 65 main panel.

lis Airport was made under radar control combined with back course of the Minneapolis ILS system. Final approach was made at about 120 mph., faster than normal, and plane demonstrated excellent aerodynamic handling qualities at this speed. Landing was made with full flaps and plane touched down at about 85 mph. Low speed characteristics are excellent and braking is easy.

Avionics gear, and the chargeable oxygen bottle, is housed in the nose on shelfs, for easy maintenance accessibility. Access doors on either side are opened by releasing Dzus fasteners. Units are cooled by an opening at the top of the nose section. Induction and cabin air is supplied by intakes mounted on lower sides of the nose. Section also contains hydraulic brake reservoir, deicer timer remote compass amplifier.

Large door on left hand side, with built-in steps, is used for cabin access; door lifts upward into the fuselage for closing. Pilot's cockpit is roomy and comfortable with all controls in easy reach. Instruments all are back-lighted in red for quick reading and lowered eye strain on night flights.

Engine Air

Induction air has three positions—filter, automatic and ram—which are controlled by the landing gear position. If the gear is down, the air is filtered, and up, ram. Two push-pull controls under the instrument panel select warm air to combat any possible induction system icing.

Plane has a 230 gal. fuel capacity in two independent systems which are controlled by a cross-feed. Beech has developed a fuel management system, mounted at the pilot's left, which gives him a schematic outline of the fuel system plus gages and tank/cross-feed controls. Each fuel system has one main tank and three interconnected auxiliaries, with submerged booster pumps. Control system includes a purge line to bleed fuel lines from the cockpit. Primers are electric and ignition is two Scintilla magnetos controlled by toggle switches.

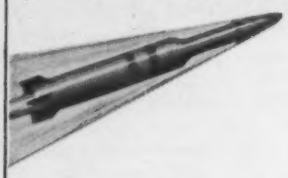
Oil for the Lycoming engines is supplied by a dry sump, full pressure system. Two 4.0 gal. tanks are mounted behind nacelle firewalls. The pilot can operate a floor-mounted shutoff valve to hold oil in the tanks in case of fire.

The electrical system includes two 28 v. 100 amp. engine-driven generators, which cut in at 1,300 rpm. A 24 v. nickel cadmium battery is used for starting and ground operations, although an external power receptacle has been provided on nacelles. Push-to-reset circuit breakers are mounted on a panel on the copilot's instrument panel. Power for the glide slope, attitude indicator and slave compass come from two 100 v. single phase inverters (one main and one spare).

Flaps are slotted and electrically operated. Gear, also electrically operated, protrudes slightly below the fuselage when retracted for protection in case of a gear-up landing. Gear is actuated by a 28 v. motor which drives torque tubes connected to jack-screw activators in each nacelle. In emergencies, the gear can be raised and lowered by pumping a sprocketed gear handle located at the pilot's right floor. Electrical gear handle is located on the instrument panel,

MODEL 65 has basic Twin Bonanza wing and tail section; wing has 5 in. tip extensions. Gear protrudes slightly when retracted.

ELECTRONICS: Over, on and under...



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Autonetics
A Division of North American Aviation, Inc.

Beechcraft Model 65 Queen Air

Performance (at maximum gross weight 7,700 lb.)	
Cruising speed:	
At 70% power (2,750 rpm.) at 15,200 ft	214 mph.
At 70% power (2,750 rpm.) at 10,000 ft	205 mph.
At 65% power (2,600 rpm.) at 10,000 ft	200 mph.
At 65% power (2,750 rpm.) at 16,800 ft	210 mph.
High speed at 12,000 ft	239 mph.
Rate of climb at sea level—two engines	1,300 fpm.
Single engine climb (7,700 lb. gross weight)	180 fpm.
Single engine climb (7,000 lb. gross weight)	295 fpm.
Single engine climb (6,500 lb. gross weight)	390 fpm.
Service ceiling—two engines (100 fpm. climb reserve):	
At 7,700 lb. gross weight	27,000 ft.
At 7,000 lb. gross weight	29,500 ft.
At 6,500 lb. gross weight	31,300 ft.
Service ceiling—single engine (50 fpm. climb reserve):	
At 7,700 lb. gross weight	12,100 ft.
At 7,000 lb. gross weight	14,100 ft.
At 6,500 lb. gross weight	15,500 ft.
Absolute ceiling—two engines:	
At 7,700 lb. gross weight	28,500 ft.
At 7,000 lb. gross weight	30,900 ft.
At 6,500 lb. gross weight	32,700 ft.
Absolute ceiling—single engine:	
At 7,700 lb. gross weight	13,000 ft.
At 7,000 lb. gross weight	14,950 ft.
At 6,000 lb. gross weight	16,300 ft.
Stalling speed (gear and flaps down)	84.5 mph.
Stalling speed (flaps and gear retracted)	96.0 mph.
Cruising range at 65% power (230 gal.):	
At 200 mph. at 10,000 ft. (no reserve)	1,370 mi.
Maximum range at 45% power:	
At 165 mph. at 10,000 ft. (no reserve)	1,550 mi.
At 173 mph. at 15,000 ft. (no reserve)	1,590 mi.
Endurance:	
At 65% power, cruise at 10,000 ft. (no reserve)	6.95 hr.
At maximum range at 10,000 ft. (no reserve)	9.40 hr.
Takeoff distance (20 deg. flap):	
Ground run	1,180 ft.
Clear 50 ft. obstacle	1,560 ft.
Landing over 50 ft. obstacle (30 deg. flap):	
Landing weight	7,350 lb.
Ground run	1,280 ft.
Total over 50 ft. obstacle	1,685 ft.

(Performance figures are results of flight tests under factory-controlled conditions and will vary with individual aircraft.)

to the right of control pedestal and can be easily reached by pilot or copilot.

Brakes are single disk, and hydraulically activated. Master cylinders are connected directly to the rudder pedals. Nose wheel is steerable through 14 deg. to the left and 12 deg. to the right by direct linkage to the rudder pedals.

Engine supercharger is a single stage, single speed centrifugal blower which operates at 11.27 times the crankshaft speed. Powerplants utilize a two-stage augmentor exhaust system to assure adequate cooling in all regimes, provide additional thrust and eliminate the need for engine exit flaps.

The Simmonds SU-series fuel injection system injects fuel into the supercharger blower (which virtually eliminates induction system icing from fuel vaporization) and includes automatic altitude and temperature compensators.

Automatic rich fuel mixture is available for high power regimes, such as climb at high altitudes. If left full open inadvertently, the controls (located on the pilot's pedestal) are automatically cut off when throttles are retracted. Throttle retraction also sounds a warning horn if gear is in the "up" position; three-view gear indicator also is located in front of the copilot.

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☐ **CIRCUIT DESIGN ENGINEERS (DISPLAY)** — To analyze equipment and circuit design requirements in data utilization and display subsystems. (Electrical Engineering degree with minimum 5 years' experience required)

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Dept. AW-10

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Proposals will be received in the Department of Aeronautics Building, Brainard Field, Hartford, Connecticut, until 2:30 P.M. E.S.T. on November 23, 1959, and then publicly opened for the fixed-base operation, land-leasing and provisions of required services and facilities at Brainard Field, Hartford, Connecticut. Said proposals shall be subject to the conditions and specifications contained in "Instructions to Applicants" and shall be filed on proposal forms, both of which may be procured at the Department of Aeronautics Building, Brainard Field, Hartford, Connecticut.

The Connecticut Aeronautics Commission reserves the right to waive any informality in the proposals, to negotiate further with the applicant who most closely meets the objectives of said Commission and to reject any and all proposals.

FOR SALE

Lockheed Turbo Prop 188A-08 For Sale: Large quantity of details and sub assemblies for spares training or experimental purposes. Engines—Main gear—Nacelles—Boost units—Accessories—Valves—Actuators—Electrical—Hydraulic—Windows—Interior—etc. Bernard J. (Barney) O'Keefe, GI 4-1345, 110 Liberty St., Ridgewood, N. J.

Two Trecker Gulls. TT 1675 & 1225. Eng. 200 hrs. S.O.H. Gear removed. 8 seats. $32,500 ea. Tahoe Air Lines, Inc., Executive Aircraft Terminal, San Francisco Int. Apt. JU9-0546.

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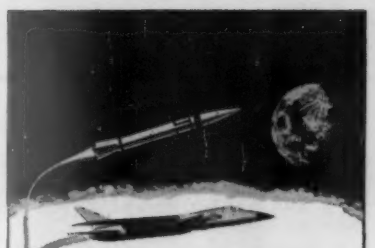


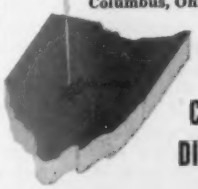
ACOUSTICS ENGINEERS

Our recently established acoustics laboratory offers ground floor opportunities to qualified acoustic engineers. Facilities men with experience in measuring and testing high intensity levels, analytical engineers capable of predicting spectrum of noise from various sources, and structural dynamicists able to predict sonic effects on missiles and aircraft are all needed immediately.

Analog Computers — Our RADAC (Research and Development Analog Computer) laboratory has recently been expanded to a 300 amplifier facility. This group has openings for mathematicians and engineers capable of programming and solving problems of missile and aircraft design arising from all engineering groups. IBM 704 computer available to augment analog equipment.

Qualified engineers are invited to send resume to:

H. Keever
Engineering Personnel Manager, Box AW–585
North American Aviation, Inc.
Columbus, Ohio.



THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Home of the T2J Buckeye and the A3J Vigilante

LETTERS

NOTAM Situation

Re the "Mr. K's Itinerary" letter from E. D. Weiner of Los Angeles (AW Oct. 12, p. 150), in which he couldn't find out about the routing of Mr. K. and party:

As Executive Director of NBAA I spent more than six hours on the telephone pleading with FAA to get the word out to the great number of civilian pilots who don't have an FAA teletype in their kitchens at home. The NOTAM system—which gets advisories directly to the air carriers and to the military—and second-hand to the civilian pilot when the ATCS stations broadcast them, or when the civilian pilot files a flight plan (85% of them do not in VFR weather) is the most antiquated and inherently dangerous public information system ever used in an environment that demands speedy, accurate dissemination of vital information to all pilots.

In fairness to the FAA—whom I urged to get the route of travel to all press and publicity media—they were handcuffed by the super-sensitivity of the security people (who had reasons to worry) and who demanded that FAA put out the special regulation with no advanced notice.

It is to be hoped that the FAA in its budgetary requests to Congress pointedly emphasizes this hopelessly inadequate and inefficiently NOTAM system concurrent with their program to "get out the word" to all pilots—350,000 of them.

William K. Lawton
Executive Director
National Business Aircraft Assn., Inc.
Washington, D. C.

Pilot Retirement

Referring to your story concerning ALPA objections to an upper age limit for jet transition training and mandatory retirement for pilots at age 60 (AW Aug. 3, p. 36), I was initially taken in by Mr. Sayen's remark that only one of 27 accidents involved a pilot over 50. Perhaps Aviation Week can get him to reveal the following information:

1. How many over 50 pilots are there at present, and how many in other age groups?
2. In the period during which the 27 accidents occurred, how many route-miles were flown by each of these age groups?

I have nothing to go on except what I read in AW and a little horse sense. With these qualifications stated, it seems to me that past experience is a particularly poor criterion by which to judge 60-year-old airline pilots—simply because we haven't got any past experience to speak of. A recent AW article (July 6, p. 33) said that as of 1946 there were no airline pilots 60 years old or over. No doubt there are some now but not many. The problem is obviously in the future, not the past, and it is to this period that the FAA seems to be directing its attention.

The FAA appears to be applying the abundant evidence that in other occupations persons over 60 have a generally lower level of physical acuity and a relatively greater incidence of sudden and unforeseen incapacitation. But is 60 some magical cutoff age? Of course it is not, but if we wait until we are perfectly certain that the pilots are too old to be safe we shall need no guess work by actuaries; the accidents will give us all the data we need.

Mr. Sayen is concerned over lost salaries due to premature retirement. No one wants to deny an airline captain his 30 grand a year any earlier than necessary. I presume that if he has been making that kind of money for several years he may have put a little away, and won't be a charity case. This point is in any case completely irrelevant in a discussion of the probable safety and reliability of pilots. The uncomplaining passenger will simply have to pay a little more for his ticket in order to pay premature retirement salaries—I don't think he'll mind if he's a little more sure of getting where he's going.

Alan T. English
Burlington, Mass.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Lockheed TV-2

I would like to make a correction on the article "TT-1 Demonstrates Acrobatic Capability," written by Richard Sweeney, p. 128 of the Sept. 21 issue.

One paragraph of this article stated: "The Navy also is having cadets first fly piston-powered Beechcraft (T-34) aircraft, then accomplish the changeover to the Pinto prior to flying the more advanced North American TV-2 (Air Force T-33)." This sentence is not correct as the TV-2 (Air Force T-33) is built by Lockheed Aircraft Corp., not North American.

Frank R. Field
Lockheed Field Service Representative
Fort Walton Beach, Fla.

(*Reader Field is correct. The Lockheed T2V now is the Navy's basic jet trainer Some cadets will begin to train in the North American T2J as it becomes available beginning in November.—Ed.*)

Word Choice

I was surprised to see you use the word acrobatic in preference to aerobatic in describing the TT-1's capabilities. I don't wish to appear pedantic over the use of a word, but Webster's seems to indicate that aerobatic is correct although there seems to be a propensity to use acrobatic. Surely one associates the word acrobatic with circuses or gymnastics? Perhaps some of your readers may have other views on this?

George A. Fulford
Seattle, Wash.

Silent on Noise

Concerning the noise complaints I have read about in Aviation Week lately; I think that the people who live near New York's International Airport just like to complain. I live just off the north end of the north-south runway at Seattle-Tacoma Airport. It's true that about 30% of the people who live here in the area get their total living from employment at Boeing Airplane Co., which makes some of the big jets. And they would be the last to complain about noise. But we who have no connection with the aircraft industry in any way have not done any complaining since the big jets have started using Seattle-Tacoma Airport.

The 707s and DC-8s make noise, true, but they are gone fast. The noisiest things around her are the old Connies used by Pacific Northern Airlines. They seem to sit and rumble for minutes on end.

Earl L. Thompson
Seattle, Wash.

Smallest Airline

May I lay challenge to your belief (AW Aug. 3, p. 38) that Cayman Brac Airways, Ltd. is the world's smallest airline in regular schedule?

Australians are proud to claim this distinction for one of its earlier fliers, Capt. Jimmy Woods, of Perth, Western Australia, who since the last war has operated Woods Airways Pty., Ltd. from Perth Airport to Rottnest Island 26 mi. away.

Using a 10-seat Avro Anson he flies a regular daily service and is flying with all the skill he showed when he entered the London-Melbourne Centenary Air Race in 1937. He is 65.

For purposes of challenging Cayman, here are the complete statistics of Woods Airways for the last calendar year compiled by the Department of Civil Aviation, under whose license he operates.

Total route miles	26
Hours flown	250
Miles flown	25,900
Passengers embarked	4,560
Passenger miles	118,000
Seat miles available	200,600
Passenger load factor	58.8%
Short ton miles passenger	11,799
Short tons freight	13.8
Short ton miles freight	360
Short tons mail	2.0
Short ton miles mail	51
Total short ton miles performed	12,210
Short ton miles available	20,450
Weight load factor	59.7%

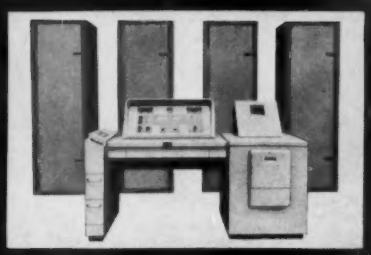
I think these figures sustain the challenge that Cayman is the world's smallest scheduled airline. This is not a criticism of your very fine magazine, but we Aussies are mighty proud of our flying records.

Frank B. Shaw
Aviation Writer
Adelaide, Australia

The Checkout that says "GO" or "NO GO"

APCHE

(Pronounced "AP-SHE")



APCHE (Automatic Programmed Checkout Equipment) is a solid-state, universal, high-speed, highly reliable, compact general-purpose tester designed especially for automatic checkout of aircraft, missile and space systems and their supporting systems. In its various versions (differing in input media, size and weight) APCHE installations may be fixed, mobile, airborne or submarineborne. APCHE was designed and is being produced as a part of RCA's ground support electronics subcontract from the Convair (Astronautics) Division of General Dynamics Corporation, prime contractor for the ATLAS Intercontinental Ballistic Missile.

The system being supplied to Convair for the ATLAS Program includes a console and four rack cabinets providing both analog and discrete test functions with a resulting printed and GO-NO GO indication. As a product of RCA's Missile Electronics and Controls Department, Burlington, Massachusetts, APCHE is one of the latest RCA developments in the field of military weapon readiness equipments.

RCA

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Such planned "cross-pollenization" is largely responsible for SMI's success in the harnessing of *basic research* in materials as a necessary ingredient in the exploitation of *applied research* in molecular electronics, micro-miniaturization, thermoelectric energy conversion and other solid state phenomena. This, in turn, provides for advances in *engineering research* into new system concepts within the fields of control and computation.

SMI would welcome the opportunity to discuss and propose solutions to your problems in the above areas.

Positions are available for scientists and engineers experienced in these fields.

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LOS ANGELES DIVISION *12500 Aviation Boulevard, Hawthorne, California*
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